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T H E
Y O U N G M A N ' S
N E W
U N I V E R S A L C O M P A N I O N ;
O R,
G e n t l e m a n ' s P o c k e t I n t e l l i g e n c e r .

C O N T A I N I N G ,

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| <p>I. The Principles of the English Language; Directions for Writing; Specimens of Letters; Forms of Address; and Rules for Penmanship.</p> <p>II. Forms of Wills and Deeds; Notes, Receipts, Bills of Parcels and Book Debts, with many other mercantile Matters, as Shipping, Invoices, and the Nature of Exports and Imports.</p> <p>III. Arithmetic in general; Vulgar and Decimal Fractions; Extraction of Roots, and their Use; Duodecimals and their Application to Artificers' Works; Board and Timber Measure.</p> <p>IV. Chronology and Geometry, with some of their most useful Problems; Plain Trigonometry; the Geography of Maps; Navigation and Astronomy, including a full Account of the Georgium</p> | <p>Sidus, or New Planet. Dialling, with the newly invented Pocket Card-Dial. The colouring of Dial-Boards, and preparing Colours for beautifying Maps, &c.</p> <p>V. The Mensuration of superficial and solid Bodies. Easy Methods of surveying Land. Cask Gauging. Information to Custom-house, Military, and Engineer Officers.</p> <p>VI. Several valuable and approved Receipts in Physic and Surgery. Method of avoiding infectious Diseases; of Consumptions of the Lungs. Fly-fishing and Angling. Directions for Swimming. Recovery of drowned Persons. On the Barometer, Thermometer, and Hygrometer; the Aurora Borealis. To estimate the Value of Life and Leasehold Estates upon two or three Lives, &c. &c.</p> |
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B E G U N

BY THE LATE MR. D. FENNING,

Author of the ROYAL ENGLISH DICTIONARY, UNIVERSAL SPELLING BOOK, READY RECKONER, YOUNG MAN'S BOOK OF KNOWLEDGE, NEW GRAMMAR OF THE ENGLISH TONGUE, &c.

A N D C O N T I N U E D

BY THE REV. J. MALHAM,

Author of the SCHOLAR'S PLAIN AND FAMILIAR GUIDE TO THE KNOWLEDGE OF VULGAR AND DECIMAL ARITHMETIC, POCKET CARD-DIAL, &c.

L O N D O N :

Printed for S. CROWDER, PATER-NOSTER-ROW.—1788.

[Price Two Shillings and Sixpence.]



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O R

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P R E F A C E.

THE established character of Mr. Fenning's many valuable and well known books, for the use of schools, renders it altogether unnecessary to make any long address on the present occasion, especially to those who are already acquainted with his other publications; but as this work may fall into the hands of some young persons and others, who have not had this advantage, and, besides, as it is but in part compiled by himself, it may not be improper for the Editor to say a few words as to its design and execution.

As the acquisition of useful and practical knowledge, and the diffusion of it among the young and uninformed part of the species, was Mr. Fenning's ruling passion, it is natural to conclude, that he had finished this, and perhaps some other works, before his decease. Part of the manuscript, however, was unhappily lost; but so much of it, at the same time, was by good fortune preserved, as to shew the particular objects the Author had in view in planning the production. The prosecution, therefore, of these views, and the continuation and completion of the work, was left to the Editor; and as he has not the vanity to think (whatever may be his knowledge in other respects) that he has more rational notions with regard to the education of youth, than the late Mr. Fenning, who perhaps judged as wisely in that respect as any man that ever existed, he has endeavoured, as far as he could, to adhere to the plan, which, he imagines, the Author would have pursued, had he lived to finish the performance.

IN pursuance of this design, and in order to render the work (what the Author seems to have intended it)

an easy introduction to the **YOUNG MAN'S BOOK OF KNOWLEDGE**, the Editor has introduced, and has treated at some length, as great a variety of subjects, as the narrow limits, to which he was confined, would possibly admit. To have introduced a greater number would have obliged him to treat each of them in so slight and superficial a manner, as to make them of little use; and to have introduced a smaller, would at once have been disappointing the reader's just expectations, and falling short of the original design which the author had formed. What the particular subjects are, will partly appear from the copious title-page, and still more fully from the Index or Table of Contents; and it is hoped, that the reader, on a careful perusal, will find them to be both so numerous and important, and to be treated, though briefly, yet so distinctly, as to bestow upon the book a decided superiority over every thing of the kind, and to shew that it justly merits the title, we have given it, of the **YOUNG MAN'S NEW UNIVERSAL COMPANION.**

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✂ The Binder is desired to place the Plate of the
CARD DIAL between P. 344 and 345.

THE
YOUNG MAN'S
NEW
UNIVERSAL COMPANION.

The FIRST PRINCIPLES of the ENGLISH
LANGUAGE.

AS every man, that is raised but one degree above the very lowest of the vulgar, ought to be able to speak and write his mother tongue, if not elegantly, at least grammatically and correctly, I shall here endeavour to lay before the reader a short but comprehensive view of the first principles of the English language.

ORTHOGRAPHY.

ORTHOGRAPHY is the art of writing words right, and likewise of pronouncing them properly.

The English Alphabet consists of twenty-six letters, namely,

A, a; B, b; C, c; D, d; E, e; F, f; G, g; H, h; I, i; J, j; K, k; L, l; M, m; N, n; O, o; P, p; Q, q; R, r; S, s; T, t; U, u; V, v; W, w; X, x; Y, y; Z, z.

These letters are divided into vowels and consonants. The vowels are *a, e, i, o, u, y*. All the rest are consonants. *Y* indeed is sometimes a consonant as well as a vowel. It is a consonant in the beginning of words, as *yes, yet, your*. In the middle and end of words, it is always a vowel, as *flying, crying, fly, cry*.

The different sounds of these letters, whether taken separately, or united together, are so well known to every Englishman, that I shall not take up much time at present in enlarging upon them. Besides, it may be observed, that it is as impossible to communicate the true sound of letters in writing, as it is to make a man hear with his eyes, or see with his ears, or to substitute one sense in the room of another. A few cursory remarks, however, may not be improper.

E at the end of words commonly lengthens the preceding vowel, as *bar, bare*; *car, care*; *far, fare*; *mar, mare*; *star, stare*; *din, dine*; *fin, fine*; *pin, pine*; *cag, cage*; *rag, rage*; *wag, wage*; *cub, cube*; *tub, tube*.

I is sometimes sounded like *ee*, as in *bombasin, capuchin, machine, magazine*, and a few other words.

O is sounded like *oo* in *do, Rome, tomb, womb*. In *women* it is pronounced like *i*, as *wimen*. *C* sounds hard, like *k*, before *a, o, u, l*, and *r*; as *can, cost, cup, clean, crab*. It sounds soft, like *s*, before *e, i*, and *y*; as *cellar, circle, cynick*. *Ch* is sounded like *tsh*, as *chance, check, chin, chop, churl*; but in words derived from the Greek or Latin, it is sounded like *k*, as *chaos, choler, chymist, chyle, chord*. In words derived from the French it is sounded like *sh*, as *chaise, chevalier, machine*. In *choir* and *choirister*, it is sounded like *qu*.

G has sometimes a hard, and sometimes a soft sound. It has a hard sound before *a, o, u, l*, and *r*; as *gaze, got, gun, globe, grain*. It is likewise hard at the end of words, as *lag, flag, leg, peg*. It is also hard before *i*, as *giddy, girdle*; except in *giant, gibbet, gibe, giblets, giles, gilliflower, gimcrack, gimp, gin, ginger, gingle, gipsy*, and a few other words. It is generally soft before *e*, as *gentle, generous*; except in *gear, geld, geese, gewgaw*. Before *n* it is mute, as *gnash, gnaw, reign, reign*. *Gh*, at the end of some words, is sounded like *ff*, as *laugh, cough, tough, rough, enough*.

H, at the beginning of some words, is almost, if not entirely, mute, as *heir, herb, hour, honest*.

S in some words is not sounded, as *isle, island, demesne, viscount, Carlisle*.

Ti before a vowel sounds like *shi*, as *addition, multiplication, subtraction, reduction*; except an *s* goes before it, and then it retains its natural sound, as *bestial, fustian*,

fustian, &c. It likewise retains its natural sound, when a consonant follows it, as *tide*, *tile*, *tin*. It does the same before comparatives in *er*, and superlatives in *est*, from adjectives ending in *y*, as *loftier*, *loftiest*, from *lofty*; as also in the plural number of nouns, and the second and third person of verbs ending in *ty*, as *beauties*, *counties*, to *empty*, thou *emptiest*, he *emptieth*, or *emptied*.

As to the right spelling of words, I know of no method so good for acquiring the art of doing it, as by attending carefully to what we read; for books are always well spelled according to the orthography of the times. Some words indeed are doubtful, being spelled differently by different authors of equal authority; but those are few: and in those cases every man has his option, because he may plead his authority either way: but where there is but one right way of spelling a word, a man of the least education should be ashamed not to know it.

However, as many persons who can spell tolerably well, are sometimes apt to commit blunders in spelling words, the same, or nearly the same in sound, but different in signification, I shall here subjoin a catalogue of these words, in order to enable the reader to spell them right.

A CATALOGUE of WORDS, the same, or nearly the same in SOUND, but different in SIGNIFICATION.

A	
A <i>BEL</i> , Cain's brother	<i>All</i> , every one
<i>A Bell</i> , of metal	<i>Awl</i> , to bore holes
<i>Able</i> , powerful	<i>Ale-hoof</i> , an herb
<i>Accidence</i> , a book	<i>Aloof</i> , at a distance
<i>Accidents</i> , chances	<i>Alloy</i> , to give ease
<i>Account</i> , esteem	<i>Alloy</i> , base metal
<i>Accompt</i> , reckoning	<i>Alley</i> , a narrow passage
<i>Achor</i> , a valley	<i>Allv</i> , a confederate
<i>Acre</i> , of land	<i>A Lye</i> , a falsity
<i>Advice</i> , counsel	<i>Allowed</i> , granted
<i>Advise</i> , to counsel	<i>Aloud</i> , to speak so
<i>Ale</i> , malt liquor	<i>Altar</i> , for sacrifice
<i>Ail</i> , trouble	<i>Alter</i> , to change
	<i>Amifs</i> , wrong
	B 2 <i>A Miss</i> ,

A Mifs, a concubine
Ant, a pismire
Aunt, a father's sister
A Peal, ringing
Appeal, to higher powers
A Peer, a Lord
Appear, to be seen
A Rose, a flower
Arose, did rise
Air, we breathe
Are, they be
Heir, to an estate
Arrant, notorious

Errand, a message
Arras, Tapestry
Arrows, to shoot
Harafs, to trouble
A scent, smell
Ascent, going up
Assent, agreement
Assistance, Help
Assistants, Helpers
Augur, a Southsayer
Augre, for Carpenters
Ax, to cut wood
Acts of parliament

B

Babel, the tower
Babble, to prate
Bacon, Hog's flesh
Baken, in the oven
Beckon, to make a sign
Beacon, to fix on a hill
Bail, a surety
Bale, of cloth
Bald, without hair
Bawl'd, cry'd out
Ball, a round substance
Bawl, to cry aloud
Barbara, a woman's name
Barbary, in Africa
Barberry, a fruit
Bare, naked
Bear, a beast
Bays, bay trees
Baize cloth,
Base, vile
Bass, in music
Be, are
Bee, that makes honey
Beer, malt liquor
Bier, to carry the dead
Bel, an idol
Bell, to ring
Belly, part of the body

Belie, to speak falsely
Berry, a small fruit
Bury, to inter
Blew, did blow
Blue, a colour
Board, a plank
Boar'd, a hole
Boar, a beast
Bore, to make a hole
Boor, a country fellow
Bold, brave
Bowl'd, cast as a bowl
Bolt, of the door
Boult, in the mill
Beau, a fop,
Bow, to bend
Bough, of a tree
Boy, a lad
Buoy, of an anchor
Bread, to eat
Bred, brought up
Breeches, to wear
Breaches, broken places
Bruit, a report
Brute, a beast
Burrow, for coney
Borough, a corporation
By, near

Buy,

Buy, to purchase
Brews, he breweth
Bruise, a hurt

Brewis, of fat and bread
Bufs, a fishing vessel
Buz, the noise of a fly

C

Caen, in Normandy
Cain, the murderer
Cane, to walk with
Calais, in France
Chalice, a cup
Call, by name
Cawl, of a periwig
Canon, a rule
Cannon, a great gun
Capital, chief
Capitol, a tower in Rome
Career, full speed
Carrier, that carrieth
Cellar, for liquors
Seller, of goods
Censer, for incense
Censor, a reformer
Censure, judgment
Centaury, an herb
Century, a hundred years
Centry, a soldier on guard
Chair, to sit in
Chare, a job of work
Choler, rage
Collar, for the neck, or of
 brawn
Ceiling, of a room
Sealing, with a seal
Cittern, an instrument
Citron, a fruit
Choir, of a cathedral

Quire, of paper
Clause, of a sentence
Claws, of a beast or bird
Coat, a garment
Cot, a small house
Comb, for the hair
Come, walk hither
Comet, a blazing star
Commit, to do
Common, usual
Commune, to converse
Council, an assembly
Counsel, advice
Coarse, not fine
Course, to be run
Currant, a fruit
Current, passable, or a
 stream
Courant, a messenger, or
 news-paper
Cousin, a relation
Cozen, to cheat
Cymbal, a musical instru-
 ment
Symbol, a mark
Cypress, a tree
Cyprus, an island
Cruse, a little vessel
Cruise, by the sea-coast
Cygnets, a young swan
Signet, a seal.

D

Dane, of Denmark
Deign, to vouchsafe
Dam, to stop water
Damn, to condemn
Dear, of great value

Deer, in a park
Deceased, dead
Diseased, sick
Decent, becoming
Descent, going down

Dissent, to disagree
Deep, low in the earth
Diep, a town in France
Defer, to put off
Differ, to disagree
Dew, a falling mist
Due, owing
Do, to perform
Doe, a female deer
Dough, paste of leaven
Don, a Spanish Lord
Done, acted

Dun, a colour
Dolphin, a fish
Dauphin, the French
 King's eldest son
Devices, inventions
Devizes, a town
Doer, that doth
Door, of a house
Dragon, a beast
Dragoon, a soldier
Draught, of drink
Drought, dryness.

E

Ear, of the head
E'er, ever
Year, twelve months
Earth, the ground
Hearth, of a chimney
Easter, a festival
Esther, a woman's name
Eaten, devoured
Eaton, a town's name
Eminent, famous
Imminent, over head

Enow, in number
Enough, in quantity
Enter, to go in
Inter, to bury
Envy, hatred
Envoy, a messenger
Exercise, labour
Exorcise, to conjure
Extant, in being
Extent, breadth and length

F

Fain, desirous
Feign, to dissemble
Faint, weary
Feint, a pretence
Fair, beautiful, or a market
Fare, victuals, or a common hire
Feed, to eat
Fee'd, rewarded
File, of metal
Foil, to overcome
Phillip, with the finger
Philip, a man's name
Fir, wood
Fur, hair

Flower of the field
Flour, meal
Floor, of a room
Follow, to come after
Fallow, ground untill'd
Flea, an insect
Flee, to escape
Flue, of a chimney
Flew, did fly
Forth, abroad
Fourth, in number
Foul, dirty
Fowl, a bird
Francis, a man's name
Frances, a woman's name
Frays, quarrels

Fraise,

Fraise, a pancake with bacon

Frieze, a cloth
Freeze, with cold.

G

Gall, of a beast
Gaul, France
Garden, of herbs
Guardian, an overseer
Genteel, graceful
Gentile, Heathen
Gentle, mild
Gesture, carriage
Jester, a merry fellow
Gilt, with gold
Guilt, of sin

Glutinous, sticking
Gluttonous, greedy
Grate, for coals
Great, large
Grater, for nutmeg
Greater, larger
Groan, to sigh
Grown, increased
Grot, a cave
Groat, four pence.

H

Hail, frozen drops of rain
Hale, healthy, to call
Hall, in a house
Hawl, to pull
Heel, of the foot
Heal, to cure
He'll, he will
Hare, a beast
Hair, of the head
Harsh, severe
Hash, minced meat
Haven, a harbour
Heaven, a place of happiness
Hart, a beast
Heart, of the body
Herd, of cattle
Heard, did hear
Hard, not soft, difficult
Here, in this place
Hear, with the ears
Hie, make haste
High, lofty
Hoy, a small ship

Him, that man
Hymn, a spiritual song
Higher, taller
Hire, wages
His, of him
Hiss, as a snake, to deride
Hear, frost
Whore, a lewd woman
Hole, hollowness
Whole, entire
Ho! lo! to call
Hallow, to make holy
Hollow, having a cavity
Holy, sacred
Wholly, entirely
Holly, a tree
Home, one's house
Whom? what man?
Holm, a sort of oak
Hoop, for a tub
Whoop, to cry out
Hue, colour
Hew, to cut
Hugh, a man's name.

I

I, myself
Eye, to see with
Idle, lazy
Idol, an image
I'll, I will
Ile, of a church
Isle, an island
Oil, of olive

Employ, work
Imply, to signify
In, within
Inn, for travellers
Incite, to stir up
Insight, knowledge
Ingenious, of quick parts
Ingenuous, candid

K

Ketch, a ship
Catch, to lay hold of
Kill, to slay
Kiln, for lime
Kind, good-natured
Coin'd, at the mint

Knave, a cheat
Nave, of a wheel
Knight, by honour
Night, darkness
Kennel, for dogs
Channel, for water

L

Lain, did lie
Lane, a narrow passage
Latin, the Roman tongue
Latten, tin
Lattice, of a window
Lettice, a woman's name
Lettuce, an herb
Lease, of a house
Leash, a string, three
Lies, dregs of wine
Leaper, that leapeth
Leper, one leprous
Lessen, to make less
Lesson, to be read

Least, smallest
Lest, for fear
Lethargy, sleepiness
Liturgy, common prayer
Lier, in wait
Lyar, a teller of lies
Limb, a member
Limn, to paint
Line, length
Loin, of veal
Lo! behold
Low, humble
Lose, to suffer loss
Loose, to let go

M

Made, finished
Maid, a young woman
Main, chief
Mane, of a beast
Male, the He
Mail, armour
Manner, custom

Manor, a lordship
Market, for traffic
Mark it, mind that
Marsh, watry ground
Mash, for a horse
Mesh, of a net

Martin,

Martin, a man's name
Marten, a bird
Mead, a meadow
Mede, one of Media
Mean, base
Mien, carriage, aspect
Meat, to eat
Meet, fit
Mete, to measure
Message, an errand
Messuage, a house
Mews, for horses
Muse, to meditate
Mighty, powerful

Moiety, half
Mile, in length
Moil, to labour
Might, strength
Mite, in cheese
Moat, a ditch
Mote, in the eye
Moan, to lament
Mown, cut down
More, in quantity
Mower, that mows
Moor, barren ground, a
 black

N

Naval, belonging to ships
Navel, of the belly
Nay, not
Neigh, as a horse
Neither, none of the two
Nether, lower
New, not old
Knew, did know

Nice, curious
Noise, clamour,
Not, denying
Knot, to tie
Note, a mark, or, of one's
 hand
Nose, of the face
Knows, understands.

O

Oar, of a boat
O'er, over
Ore, of metal
Of, belonging to
Off, at a distance
Oh! alas!
Owe, to be indebted

One, in number
Won, at play
Order, a rule
Ordure, dung
Our, of us
Hour, sixty minutes:

P

Palate, of the mouth
Pallet, a little bed
Pale, colour
Pail, a vessel
Pall, a funeral cloth
Paul, a man's name
Parasite, a flatterer

Parricide, a murderer
Parson, of a parish
Person, somebody
Peal, of bells
Peel, of an onion, &c.
Pear, a fruit
Pair, a couple

Pare,

Pare, to cut off
Pick, to chuse
Pique, a quarrel
Pint, half a quart
Point, a stop
Place, of abode
Plaice, a fish
Plait, the hair
Plate, metal
Please, to content
Pleas, excuse
Pole, a long stick
Poll, to cut the hair
Pore, of the skin
Poor, beggarly
Possy, of flowers

Quire, of paper
Choir, of singers

Rack, to torment
Wreck, of a ship
Rain, water
Reign, of a king
Rein, of a bridle
Raise, lift up
Rays, sun beams
Raisin, a fruit
Reason, argument
Race, to run
Rase, to demolish
Red, a colour
Rid, to disencumber
Read, a book
Reed, a shrub
Relick, a remainder
Relict, a widow
Rest, quiet
Wrest, to pervert
Rhyme, in verse
Rime, a hoar frost
Rice, Indian corn
Rise, advancement

Poesy, poetry
Pour, to empty
Power, might
Practice, exercise
Practise, to exercise
Pray, to entreat
Prey, a booty
Presence, being here
Presents, gifts
Princes, king's sons
Princess, a king's daughter
Principal, chief
Principle, the first rule
Profit, advantage
Prophet, a foreteller,
Prophecy, a foretelling
Prophefy, to foretell

Q

Queen, a king's wife
Quean, a harlot.

R

Rye, Corn
Wry, crooked
Ring, the bells
Wring, the hands
Rite, ceremony
Right, just
Wright, an artificer in wood
Write, with a pen
Rode, did ride
Road, the highway
Row'd, did row
Roe, a deer, eggs of a fish
Row, a boat, rank or file
Rome, a city
Room, part of a house
Rote, by heart
Wrote, did write
Wrought, did work
Rough, not smooth
Ruff, a band
Roof, top of a house

Sail,

S

Sail, of a ship
Sale, of goods
Satiety, fullness
Society, company
Saviour, that saveth
Savour, smell, taste
Scene, of the stage
Seen, beheld
Sea, ocean
See, with the eyes
Seas, great waters
Seize, to lay hold of
Cease, to leave off
Sent, ordered away
Scent, a smell
Ship, for sailing
Sheep, a beast
Shore, the sea-coast
Sewer, a common drain
Shown, did show
Shone, did shine
Sign, a token
Sine, in geometry
Site, situation
Cite, to summon
Sight, view
Sink, to go down
Cinque, five
Slight, to despise

Sleight, of hand
Sloe, a sour fruit
Slow, tardy
Slough, a puddle
Sole, of a shoe
Soul, of a man
So, thus
Sow, feed
Some, a part
Sum, of money
Son, a man-child
Sun, in the firmament
Soon, quickly
Swoon, to faint
Sore, an ulcer
Soar, to mount upward
Soar'd, did soar
Sword, a weapon
Stare, to look earnestly
Stair, a step
Stile, to get over
Style, of writing
Straight, not crooked
Strait, narrow
Succour, help
Sucker, a young twig
Sue, to prosecute at law
Sew, with a needle

T

Tail, the end
Tale, a story
Tame, not wild
Thame, a town
Tare, weight allowed
Tear, to rend in pieces
Than, in comparison
Then, at that time
There, in that place
Their, of them
Throne, a seat of state

Thrown, cast
Tie, to make fast
Toy, a play thing
Tide, flux of the sea
Ty'd, made fast
Tile, of a house
Toil, to take pains
Time, when
Thyme, an herb
Team, of horses
Teem, with child

To,

To, unto
Toe, of the foot
Too, likewise
Tow, to draw along
Two, couple
Told, as a tale

Toll'd, as a bell
Tongs, for the fire
Tongues, languages
Tour, a journey
Tower, of defence

V

Vacation, ceasing
Vocation, a calling
Vail, to let fall
Vale, a valley
Veil, a covering
Vain, fruitless
Vane, a weathercock
Vein, of the body
Valley, a dale

Value, worth
Volley, of shot
Vassal, a slave
Vessel, for use
Vial, or *phial*, a glass
Viol, a fiddle
Vice, ill habit
Vice, for a workman
Voice, a sound.

U

Ure, use
Ewer, a bason
Your, of you

Use, to be wont
Ewes, sheep

W

Wade, in the water
Weigh'd, in the balance
Wail, to mourn
Whale, a sea-fish
Wane, decrease
Wain, a waggon
Wean, a child
Wait, to stay for
Weight, heaviness
Ware, merchandise
Wear, cloths
Where, in what place
Were, they were
Waste, to spend
Waist, the middle
Way, to walk in
Weigh, to poize
Wey, 40 bushels
Whey, of milk
Weal, good

Wheal, a pimple
Wheel, of a coach
Wield, to manage
Wild, untamed
Wen, a swelling
When, at what time
What, which
Wat, *Walter* a man's name
While, in the mean time
Wile, a trick
White, a colour
Wight, an island
Whore, a lewd woman
Hoar, frost
Witch, a sorceress
Which, who or what
Wist, knew
Whist, silence
Wood, of trees
Wou'd, was willing

Y *Yarn*,

M. Y.

Yarn, woollen
 Yearn, to pity
 Earn, to get
 Ye, yourselves

Yea, yes
 Yew, a tree
 Ewe, a female sheep
 You, yourself.

E T Y M O L O G Y.

ETYMOLOGY teaches the derivation of one word from another, and the different methods in which the sense of the same word is varied; as *tree, trees; high, higher; I walk, I walked*. In the English language there are nine kinds of words, or, as they are commonly called, parts of speech. These are the Article, Noun, Pronoun, Verb, Participle, Adverb, Preposition, Interjection, and Conjunction.

ARTICLE. The articles are two in number, viz. *a* or *an*, and *the*. *A* or *an* shews, that one only of a kind is meant, but no one in particular; and hence it is called the *indefinite article*; as *a swift horse*, that is, one of the horses that are swift, without mentioning any particular horse. *A* is used before words beginning with a consonant, as *a father*: and *an* before words beginning with a vowel, as *an uncle*; or an *h* mute, as *an heir*. *The* confines the sense to one or more of a kind. *This is the cow that I bought; these are the sheep that I sold*: that is, this particular cow, and these particular sheep.

NOUNS. Nouns are of two kinds, either substantive or adjective. A substantive noun will make sense by itself, as *a man, a woman*. An adjective noun will not make sense by itself, as *strong, handsome*; unless it be joined with a substantive, and then it will make sense, as *a strong man, a handsome woman*.

SUBSTANTIVES. As to substantive nouns, there are three things to be observed, namely, their gender, their number, and their case.

GENDER. There are two genders, the masculine and the feminine; the first denoting males, the second denoting females; and there is likewise a third gender, called the neuter gender, denoting such beings as are either male or female, as *a child, a sparrow*. The English sometimes distinguish the different genders, or sexes, by different words, as

C

Male

Male.	Female	Male.	Female.
<i>Bachelor,</i>	<i>Maid, Virgin</i>	<i>King,</i>	<i>Queen.</i>
<i>Boar,</i>	<i>Sow.</i>	<i>Lad,</i>	<i>Lass.</i>
<i>Boy,</i>	<i>Girl.</i>	<i>Lord,</i>	<i>Lady.</i>
<i>Bridegroom,</i>	<i>Bride.</i>	<i>Man,</i>	<i>Woman.</i>
<i>Brother,</i>	<i>Sister.</i>	<i>Master,</i>	<i>Mistress.</i>
<i>Buck,</i>	<i>Doe.</i>	<i>Miller,</i>	<i>Spawner.</i>
<i>Bull,</i>	<i>Cow.</i>	<i>Nephew,</i>	<i>Niece.</i>
<i>Bullock,</i>	<i>Heifer.</i>	<i>Ram,</i>	<i>Ewe.</i>
<i>Cock,</i>	<i>Hen.</i>	<i>Sloven,</i>	<i>Slut.</i>
<i>Dog,</i>	<i>Bitch.</i>	<i>Son.</i>	<i>Daughter.</i>
<i>Drake,</i>	<i>Duck.</i>	<i>Stag,</i>	<i>Hind.</i>
<i>Father,</i>	<i>Mother,</i>	<i>Uncle,</i>	<i>Aunt.</i>
<i>Friar,</i>	<i>Nun.</i>	<i>Widower,</i>	<i>Widow.</i>
<i>Gander,</i>	<i>Goose.</i>	<i>Wizard,</i>	<i>Witch.</i>
<i>Horse,</i>	<i>Mare.</i>	<i>Whore-mon-</i>	<i>Whore or</i>
<i>Husband,</i>	<i>Wife.</i>	<i>ger,</i>	<i>Strumpet.</i>

To nouns of the neuter gender we sometimes add an adjective, to distinguish the difference of sex, as *a male child, a female child.* Sometimes a substantive, as *a man-servant, a maid-servant.*

The feminine gender is sometimes made by changing the termination of the masculine into *ess*, as

Male.	Female.	Male.	Female.
<i>Abbot,</i>	<i>Abbess.</i>	<i>Lion,</i>	<i>Lioness.</i>
<i>Actor,</i>	<i>Actress.</i>	<i>Marquis,</i>	<i>Marchioness.</i>
<i>Ambassador,</i>	<i>Ambassadress.</i>	<i>Patron,</i>	<i>Patroness.</i>
<i>Baron,</i>	<i>Baroness.</i>	<i>Prince,</i>	<i>Princess.</i>
<i>Count,</i>	<i>Countess.</i>	<i>Prior,</i>	<i>Prioress.</i>
<i>Deacon,</i>	<i>Deaconess.</i>	<i>Poet,</i>	<i>Poetess.</i>
<i>Duke,</i>	<i>Duchess.</i>	<i>Prophet,</i>	<i>Prophetess.</i>
<i>Electer,</i>	<i>Electress.</i>	<i>Shepherd,</i>	<i>Shepherdess.</i>
<i>Emperor,</i>	<i>Empress.</i>	<i>Tutor,</i>	<i>Tutress.</i>
<i>Governor,</i>	<i>Governess.</i>	<i>Viscount,</i>	<i>Viscountess.</i>
<i>Heir,</i>	<i>Heiress.</i>		
<i>Hunter,</i>	<i>Huntress.</i>		
<i>Jew,</i>	<i>Jewess.</i>		

Some

Some nouns make their feminine in *ix*; as *Executor*, *Executrix*. *He* always implies the masculine gender; *She*, the feminine; and *it*, either the masculine or feminine, that is, the neuter.

NUMBER. There are two numbers, the singular and plural. The plural, for the most part, is made by adding *s* to the singular, as *father*, *fathers*; *mother*, *mothers*. But if the singular ends in *ch*, *sh*, *ss*, or *x*, then *es* must be added, as *ditch*, *ditches*; *brush*, *brushes*; *witness*, *witnesses*; *box*, *boxes*. Nouns ending in *f* or *fe* in the singular, make their plural in *ves*, as *sheaf*, *sheaves*; *wife*, *wives*: though several that end in *f* or *fe*, form their plural in the usual manner, only by adding *s*, as *hoof*, *hoofs*; *fife*, *fifes*: as also do most nouns ending in *ff*, as *cliff*, *cliffs*; *cuff*, *cuffs*; except *staff*, which makes *staves*. Nouns ending in *y* form their plural in *ies*, as *beauty*, *beauties*; *berry*, *berries*: unless the *y* in the singular makes part of a diphthong, that is, unless it is sounded jointly with the preceding vowel, for then *y* is retained, and the plural is formed only by adding *s*, as *day*, *days*; *way*, *ways*. Some nouns have *en* in the plural, as *man*, *men*; *woman*, *women*. Some have *ce* or *se*, as *mouse*, *mice*; *goose*, *geese*. Some nouns are the same both in the singular and plural, as *sheep*, *deer*; for we can say *one sheep*, or *a thousand sheep*; *one deer*, or *a thousand deer*. Some nouns have no singular, as *ashes*, *bellows*, *snuffers*, &c. And others have no plural, as the proper names of men, women, cities, rivers, &c. as *Matthew*, *Mary*, *Manchester*, the *Severn*; except when there are several great men of the same name, as the *Cæsars*, the *Edwards*, the *Henrys*. The case is the same with the names of virtues and vices, as *frugality*, *prodigality*; of metals, as *gold*, *silver*; of herbs, as *mint*, *sage*; and of corn and pulse, as *wheat*, *barley*; except *oats*, *tares*, *peas*, *beans*.

CASE. There are only two cases in the English language, the nominative and the genitive. The nominative is that, in which a thing is simply expressed, as *a tree*, *a river*. The genitive is that which implies property or possession; and hence it is sometimes called the possessive case. It is formed by adding *s*, with an apostrophe before it, to the nominative case, as *the tree's height*, *the river's depth*. Some

people imagine, that this *s* with the apostrophe, is only a contraction of *his*; and hence instead of *John's house*, they frequently write *John his house*. But this is a mistake; for if it were right, we might with the same propriety, instead of *Nancy's book*, write *Nancy his book*, which would be downright nonsense. The genitive likewise is sometimes formed by putting the particle *of* before it, as *the length of the day*, *the shortness of the night*. The Greek, Latin, and some other languages, have four other cases, viz. the dative, the accusative, the vocative, and the ablative; but the want of these in English is supplied by the prepositions *to*, *for*, *with*, *from*, *by*, &c.

ADJECTIVES. Adjectives admit of no variation in gender, number, or case, being joined to substantives of all genders, of both numbers, and in all cases; as *a good man*, *a good woman*, *a good thing*; *of a good man*, *of a good woman*, *of a good thing*; *good men*, *good women*, *good things*; *of good men*, *of good women*, *of good things*. The only change they undergo is in the degrees of comparison. There are three degrees of comparison, the positive, the comparative, and the superlative. The positive is that in which the quality is simply expressed, as *long*, *broad*. The comparative is that in which the quality is somewhat increased, as *longer*, *broaden*. The superlative is that in which the quality is raised to the highest degree of which it is capable, as *longest*, *broadest*. The comparative is formed by adding *r* or *er* to the positive, as *white*, *whiter*; *black*, *blacker*. The superlative is formed by adding *st* or *est* to the positive, as *white*, *whitest*; *black*, *blackest*. Adjectives of two or more syllables are commonly compared by *more* and *most*, as *humane*, *more humane*, *most humane*. The following are irregularly compared.

Positive.	Comparative.	Superlative.
Good,	Better,	Best.
Bad,	Worse,	Worst.
Little,	Less,	Least.
Much or Many,	More,	Most.
Near,	Nearer,	Nearest or Next.
Late,	Later or Latter,	Latest or Last.

PRONOUNS. Pronouns are words that supply the place of nouns, and are used to prevent the too frequent repetition of them. They are of four kinds, personal, possessive, relative, and demonstrative. Some of them have a case peculiar to themselves; it is called the oblique or objective case, and is used after most verbs and prepositions.

The personal pronouns are *I, thou, he, she, it*, with their plurals; and they are thus declined.

	Singular.	Plural.
Nominative	<i>I.</i>	<i>We.</i>
Oblique case	<i>Me.</i>	<i>Us.</i>
Nominative.	<i>Thou.</i>	<i>Ye.</i>
Oblique case	<i>Thee.</i>	<i>You.</i>
Nominative	<i>He. She.</i>	<i>They.</i>
Oblique case	<i>Him. Her.</i>	<i>Them.</i>
Nominative	<i>It.</i>	<i>They.</i>
Oblique case	<i>It.</i>	<i>Them.</i>
Genitive	<i>Its.</i>	

Some writers say *you are*, and *you were*, for *thou art*, and *thou wast*.

The possessive pronouns are *my, our, thy, your, his, her, their*; and they are no otherwise declinable except that, when they are separated from their substantives by a verb, *my* becomes *mine*; *thy*, *thine*; *our*, *ours*; *your*, *yours*; *her*, *hers*; *their*, *theirs*: as *this is my pen*; *this pen is mine*: *that is our paper*; *that paper is ours*: *this is your cart*; *this cart is yours*: *this is her glove*; *this glove is hers*: *that is their garden*; *that garden is theirs*. *His* is never changed: as *this is his cane*; *this cane is his*. *Mine* and *thine* are sometimes used for *my* and *thy*, before words that begin with a vowel, as *mine eye*, *mine ear*.

Relative pronouns are so called because they relate to some substantive going before, which is therefore called the antecedent. They are four in number, viz. *who, which, what, and whether*. *Who* is declined thus

Singular and Plural.

Nominative	<i>Who</i>
Genitive	<i>Whose</i>
Oblique	<i>Whom</i>

Whose

Whose likewise, especially among the poets, is sometimes used as the genitive of *which*, as *the river whose bottom was sandy*, instead of, *the river the bottom of which was sandy*. *What* and *whether* are not declined, *Who* properly relates to persons; *what*, to things.

The demonstrative pronouns are *This*, *that*, *other*, and *the same*. *This* makes *these* in the plural, *that* makes *those*, and *other* makes *others*. *Other*, indeed, is either singular or plural; for we say *the one side or the other*; and *other men*, *other women*. *Others* is never used but when it refers to a preceding substantive; as *some of the cattle were fat*; *others were lean*.

VERBS. A verb is a word that signifies to be, to do, or to suffer; as *I live*, *I command*, *I am commanded*. There are three kinds of verbs; active, passive, and neuter. An active verb denotes an action, as *I blame him*; a passive verb denotes a passion, as *I am blamed by him*; and a neuter verb denotes neither an action nor a passion, but rather something between both, as *I am*, *I come*, *I go*. A verb has three persons in the singular number, and three in the plural. The first person singular is *I*, the second is *thou* or *you*, the third *he*, *she*, or *it*; the first person plural is *we*, the second *ye* or *you*, and the third *they*. We must always take care to make the verb agree with its person; or, as it is commonly called, its nominative; as *I know*, *thou knowest* or *dost know*, *he knows*; *we know*, *ye or you know*, *they know*. We must never say *I knows*, as many ignorant people do. Verbs are said to be either regular or irregular. Regular verbs form their second tense, or, as it is usually called, their preter-imperfect tense, and their participle passive, in *ed*, as *ploughed*, *sowed*, *planted*. Irregular verbs either simply change the *ed* into *t*, as *mix*, *mixt* for *mixed*; or they likewise drop one of the two consonants, as *possess*, *possest*; or they also change a double vowel, or diphthong, into a single vowel, as *feel*, *felt*, *weep*, *wept*; or, finally, they form their preter-imperfect tense and participle passive in such a variety of different ways, that they cannot be reduced to any certain rules. I shall therefore present the reader with a catalogue of them, informing him, however, at the same time, that some of these verbs are conjugated regularly, as well as irregularly; and where that is the case, an asterisk is subjoined to them.

Present

UNIVERSAL COMPANION. 19

Present Tense, Preter-imperfect Tense, Participle Passive.

Abide,	Abode,	Abode.
Am,	Was,	Been.
Arise,	Arose,	Arisen.
Awake,	Awoke *,	Awoke *.
Bear,	Bare, Bore,	Born.
Beat,	Beat,	Beaten.
Begin,	Began,	Begun.
Bend,	Bent,	Bent.
Unbend,	Unbent,	Unbent.
Bereave,	Bereft *,	Bereft *.
Beseech,	Besought *,	Besought *.
Bid,	Bade,	Bidden.
Bind,	Bound,	Bound.
Bite,	Bit,	Bitten.
Bleed,	Bled,	Bled.
Blow,	Blew,	Blown.
Break,	Brake, Broke,	Broke, Broken.
Breed,	Bred,	Bred.
Bring,	Brought,	Brought.
Build,	Built,	Built.
Burst,	Burst,	Burst, Bursten.
Buy,	Bought,	Bought.
Can,	Could,	—
Cast,	Cast,	Cast.
Catch,	Caught *,	Caught *.
Chide,	Chid,	Chidden.
Choose, Chuse,	Chose,	Chosen.
Cleave,	Clave, Clove *,	Cloven.
Cling,	Clang, Clung,	Clung.
Clothe,	Clad *,	Clad *.
Come,	Came,	Come.
Cost,	Cost,	Cost.
Crow,	Crew,	Crowed.
Cut,	Cut,	Cut.
Dare,	Durst *,	Dared.
Die,	Died,	Dead.
Dig,	Dug *,	Dug *.
Draw,	Drew,	Drawn.
		Drink,

Present Tense, Preter-imperfect Tense, Participle Passive.

Drink,	Drank,	Drunk, Drunken.
Drive,	Drove,	Driven.
Eat,	Ate,	Eaten.
Fall,	Fell,	Fallen.
Feed,	Fed,	Fed.
Fight,	Fought,	Fought.
Find,	Found,	Found.
Flee,	Fled,	Fled.
Fling,	Flung,	Flung.
Ply,	Flew,	Flown.
Forsake,	Forsook,	Forsaken.
Freeze,	Froze,	Frozen.
Get,	Gat, Got,	Got, Gotten.
Give,	Gave,	Given.
Go,	Went,	Gone.
Grind,	Ground,	Ground.
Grow,	Grew,	Grown.
Hang,	Hung *,	Hung *.
Have,	Had,	
Hear,	Heard.	Heard.
Hew,	Hewed,	Hewn *.
Hide,	Hid,	Hidden.
Hit,	Hit,	Hit.
Hold,	Held,	Holden, Held.
Hurt,	Hurt,	Hurt.
Knit,	Knitted,	Knitted, Knit.
Know,	Knew,	Known.
Lay,	Laid,	Laid.
Lead,	Led,	Led.
Leave,	Left,	Left.
Lend,	Lent,	Lent.
Let,	Let,	Let.
Lie,	Lay,	Lain, Lien.
Load,	Loaded,	Loaden, Laden *.
Lose,	Lost,	Lost.
		Make,

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Present Tense. Preter-imperfect Participle Passive.
Tense.

Make,	Made,	Made.
May,	Might;	—
Meet,	Met,	Met.
Mow,	Mowed,	Mown *.
Must,	—	—
Ought,	Ought,	—
Pay,	Paid,	Paid.
Put,	Put,	Put.
—	Quoth he,	—
Read,	Read,	Read.
Rend,	Rent,	Rent.
Rid,	Rid,	Rid.
Ride	Rode,	Ridden.
Ring,	Rang, Rung,	Rung.
Rise,	Rose,	Risen.
Rive,	Rived,	Riven.
Run,	Ran,	Run.
Say,	Said,	Said.
Saw,	Sawed,	Sawn *.
See,	Saw,	Seen.
Seek,	Sought,	Sought.
Seethe,	Seethed,	Sodden.
Sell,	Sold,	Sold.
Send,	Sent,	Sent.
Set,	Set,	Set.
Shake,	Shook,	Shaken.
Shall,	Should,	—
Shave,	Shaved,	Shaven *.
Shear,	Sheared, Shore,	Shorn.
Shed,	Shed,	Shed.
Shine,	Shone *.	Shone *.
Shoe,	Shod,	Shod.
Shoot,	Shot,	Shot.
Show,	Showed,	Shown *.
Shrink,	Shrank, Shrunk,	Shrunk.
Shut,	Shut,	Shut.
Sing,	Sang, Sung,	Sung.
		Sink.

Present Tense.

Preter-imperfect Participle Passive.
Tense.

Sink,	Sank, Sunk,	Sunk.
Sit,	Sat,	Sat, Sitten.
Slay,	Slew,	Slain.
Slide,	Slid *	Slidden.
Slink,	Slunk,	Slunk.
Sling,	Slang, Slung,	Slung.
Slit,	Slit *	Slit.
Smite,	Smote,	Smitten.
Snow,	Snowed,	Shown *.
Sow,	Sowed,	Sown *.
Speak,	Spake, Spoke,	Spoken.
Speed,	Sped,	Sped.
Spend,	Spent,	Spent.
Spin,	Span, Spun,	Spun.
Spit,	Spat,	Spitten.
Split,	Split,	Split *.
Spread,	Spread,	Spread.
Spring,	Sprang, Sprung,	Sprung.
Stand,	Stood,	Stood.
Steal,	Stole,	Stolen, Stolen.
Stick,	Stuck,	Stuck.
Sting,	Stung,	Stung.
Stink,	Stank, Stunk,	Stunk.
Stride,	Strode,	Stridden.
Strike,	Struck,	Struck, Strucken.
String,	Strung,	Stricken.
Strive,	Strove *	Strung.
Strow,	Strowed,	Striven.
Swear,	Swore, Sware,	Strown.
Sweat,	Sweat, Sweet *,	Sworn.
Swell,	Swelled,	Sweat, Sweaten.
Swim,	Swam, Swum,	Swollen.
Swing,	Swung,	Swum.
Take,	Took,	Swung.
Teach,	Taught,	Taken.
Tear,	Tore, Tare,	Taught.
Tell,	Told,	Torn.
Think,	Thought,	Told.
Thrive,	Throve,	Thought.
		Thriven.
		Throw,

UNIVERSAL COMPANION. 23

Present Tense. Preter-imperfect Participle Passive.
Tense.

Throw,	Threw,	Thrown.
Thrust,	Thrust,	Thrust.
Tread,	Trode,	Trodden.
Trow,	—	—
Wear,	Wore,	Worn.
Weave,	Wove *,	Woven *.
Wet,	Wet,	Wet.
Will,	Would,	—
Win,	Wan, Won,	Won.
Wind,	Wound,	Wound *.
Wis,	Wist,	—
Wit, Wot,	Wot,	—
Work,	Wrought *,	Wrought *.
Wring,	Wrung *,	Wrung *.
Write,	Wrote, Writ,	Written, Writ, Wrote.

My design in giving this catalogue is to guard the reader against the use of improper words, and to prevent his saying (as many ignorant people do) *I see'd* for *I saw*, *I knowed* for *I knew*, *I throwed* for *I threw*, *I drawed* for *I drew*, *it blowed* for *it blew*, &c.

PARTICIPLE. A participle is a word derived from a verb, or more properly it is a certain form of a verb, which partakes of the nature of an adjective, as *sucking*, *roasted*. It even sometimes supplies the place of an adjective, as *a sucking pig*, *a roasted fowl*. There are two participles, the active and the passive. The active is formed by adding *ing* to the first person of the present tense of the verb, and striking off *e*, if the verb end in that letter; as *plant*, *planting*; *prune*, *pruning*. The passive is formed by adding *d* to the present tense of the verb, if it end in *e*; or *ed*, if it end in any other letter; as *approve*, *approved*; *condemn*, *condemned*.

ADVERBS. Adverbs, as well as prepositions, interjections and conjunctions, are sometimes called particles; that is, they are certain little words that never change their termination. They are called *Adverbs*, because they are commonly *added to verbs*, and serve to express the manner and other circumstances of an action;

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action; as *He speaks boldly, She dresses genteely, He will come to-day, I will go to-morrow.*

PREPOSITIONS. A preposition is a particle that expresses the relation which one word has to another, and performs in English what is done in Latin by cases, or the different terminations of nouns. The principal prepositions are those that follow; *above, about, after, against, among, amongst, at, before, behind, below, beneath, beside, besides, between, beyond, by, for, from, in, into, of, off, out of, on, upon, over, through, till, until, to, unto, toward, towards, under, up, with, within, without.*

INTERJECTIONS. Interjections are certain little words, that are thrown in between the parts of a sentence, to express some sudden emotion or passion of the mind; as *oh! alas! hift! hush!*

CONJUNCTIONS. Conjunctions are words that join together sentences, and shew their dependence upon each other; as *the cows and the horses are both foddered*: here *and* is a conjunction. Neither *the apples nor the pears are ripe*: here *neither and nor* are conjunctions.

SYNTAX OR CONSTRUCTION.

The English language is very simple in its construction, and a few rules are sufficient for the purpose. A verb must agree with its nominative, in number and person. For instance, we must say, *I love, I know*; and not *I loves, I knows*, as many illiterate people do. An active verb governs a noun, or rather a pronoun, in the oblique case (for it is pronouns only that have an oblique case) as, *He sent me. She brought us. He taught thee or you. He loves her. She hates him. They beat them.* If a nominative comes between the relative and the verb, the relative is put in the oblique case; as *the man whom I discharged; the woman whom I hired.* Except when a question is asked, and then it is commonly put in the nominative case, though not very grammatically; as *Who did you see? Who did you meet?*

The prepositions likewise govern the oblique case; as *send it to me. Bring it to us. Take it from him. Give it to her. Go with them. The man whom I got it from.* But if a question is asked, the relative is commonly

monly put in the nominative; as *Who did you get it from?* Sometimes the preposition is understood; as *give me some bread*; that is, *give some bread to me*: *hand me a knife*; that is, *hand a knife to me*. Conjunctions couple like cases together; as *between you and me*; not *between you and I*: for *you* is properly in the oblique case, though it is sometimes used in the nominative for *those* or *ye*. Adverbs govern no case. Some interjections take the oblique case after them; as *Ah me!* *Wo is me!*

P R O S O D Y.

Profody is that part of grammar, which teaches the true pronounciation of words, and the rules of versification. As to the rules of versification, we have nothing to do with them at present; and with regard to the true pronounciation of words, a few observations will suffice. By the true pronounciation of words is meant the giving to every letter its proper sound, and to every syllable its proper quantity or accent. The sounds of the several letters have been already explained in the beginning of this chapter; and as to the quantity or accent, though they are in some measure different, they may here be considered as the same. That syllable of a word is said to be accented, upon which the chief stress of the voice is laid. Most English words, of two or three syllables, have the accent on the first syllable, though with some exceptions. For instance, words of three syllables, ending in *ator*, have the accent on the middle syllable, as *speéktor*; and words of three syllables, derived from the Latin or French, have the accent on the last, as *introdúce*, *masqueráde*. Some polysyllables, or words of more than three syllables, seem to have two accents, as *mágnanímity*; and some three, as *incomprehénsibility*. The best way of learning the true accent of words is by reading the works of the most elegant poets, where every word has, or at least ought to have, its proper quantity or accent.

D P U N C.

PUNCTUATION.

Punctuation is the art of distinguishing, by certain marks, the several stops or pauses in a sentence. The principal marks used for this purpose are :

The <i>Comma</i>	} expressed thus {	,
The <i>Semicolon</i>		;
The <i>Colon</i>		:
The <i>Period</i> or <i>full Stop</i>		.

The *Comma* requires us to stop as long as we can count *one* ; the *Semicolon*, as long as we can count *two* ; the *Colon*, as long as we can count *three* ; and the *Period* or *full Stop*, as long as we can count *four*.

There are three other points, namely

The point of Interrogation	} marked thus {	?
The point of Admiration		!
The Parenthesis		()

The point of interrogation is placed after a question ; the point of admiration, after a word expressing wonder or surprise ; and the parenthesis serves to inclose a short sentence, which is inserted in the body of a larger one, and which though not absolutely necessary to complete the sense, helps, nevertheless, to render it much clearer. Examples of these points are to be met with in almost every book you read.

There are likewise a variety of other marks, some of which do not so frequently occur. These are

The *Apostrophe* (') which is placed at the head of letters, to shew that some letter or letters are left out, as *mov'd* for *moved*, *sow'd* for *sowed*.

An *Asterisk* (*) refers to some note in the margin or at the bottom of the page. Several of them joined together signify that there is something wanting or omitted in the passage, thus ***.

A *Caret* (Λ) shews, that some letter, syllable, or word is left out by mistake ; and this mark is put under the line exactly in the place where what is omitted should come in.

A Cir-

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A *Circumflex* (Λ) which has nearly the same shape as a *caret*, is placed over some vowel of a word, to shew that the syllable is long, as *Euphrâtes*.

A *Dialysis* (· ·) placed over the last of two syllables, shews that they do not make a diphthong, but are to be pronounced separately, as *Stanislaus*.

A *Hyphen* (-) placed at the end of a line, shews, that the last word is not finished; but that part of it begins the next line. It also serves to join compound words together, as a *drill plough*, a *hand-saw*.

An *Index* (☞) or fore-finger pointing, shews, that the passage, to which it is prefixed, contains something remarkable.

An *Obelisk* (+) or dagger, answers the same end as an *Asterisk*; that is, it points to some note in the margin, or at the bottom of the page. Several other marks are used for this purpose, such as parallel lines (||); a double *obelisk*, or obelisks formed in different manners (+ + †); figures (1. 2. 3. &c.); or letters (a. b. c. &c.)

A *Paragraph* (¶) is seldom used but in the bible, and denotes the beginning of a new subject.

Crotchets or *Brackets* ([]) serve nearly the same purpose as a *Parenthesis*.

A *Quotation* (") is put at the beginning of any passage that is cited out of another author. The *End of a Quotation* (") is put at the conclusion of the passage cited, and shews that it is completely finished.

A *Section* (§) serves to divide books or chapters into smaller parts. It is likewise sometimes used to point to a note in the margin, or at the bottom of the page.

Braces } are used to join several lines together, especially in poetry; as

Waller was smooth; but Dryden taught to join }
The varying verse, the full-resounding line, }
The long majestic march, and energy divine. }

A B B R E V I A T I O N.

Abbreviation is a method of expressing certain words by setting down only one or more of their initial letters,

ters, and putting a full stop after such letter or letters. The principal abbreviations are those that follow.

- A.* Answer
A. B. or *B. A.* Batchelor of arts
Abp. Archbishop
A. D. *Anno Domini*, in the year of our Lord.
A. M. *Artium Magister*, master of arts; or *Anno Mundi*, in the year of the world.
Ana. A physical term signifying the like quantity.
Ap. Apostle, April.
A. R. *Anna Regina*, Queen Anne; or *Anno Regni*, in the year of the reign.
Asl. P. G. C. Professor of Astronomy in Gresham College.
Aug. August.
Bart. Baronet.
B. D. Batchelor of Divinity.
Bp. Bishop.
B. V. Blessed Virgin.
C. C. C. Corpus Christi College.
Chap. Chapter.
Cl. Clerk, Clergyman.
Cr. Creditor.
C. R. *Carolus Rex*, King Charles.
C. S. *Custos Sigilli*, Keeper of the Seal.
C. P. S. *Custos privati Sigilli*, Keeper of the privy Seal.
D. Duke, Dutchy, Dutchess, &c.
D. *Denarius*, a penny.
D. D. Doctor of Divinity
Dr. Doctor or Debtor.
Dec. or *iober*, December.
Deut. Deuteronomy.
D. Dit. Ditto, the same.
E. Earl, East.
E. G. or *Ex. Gr.* *Exempli gratia*, for example.
Feb. February.
F. R. S. Fellow of the Royal Society.
Gen. Genesis.
G. R. *Georgius Rex*, King George; *Gul. Rex*, King William.
H. S. *Hic Situs*, Here lies.
Ibid. *Ibidem*, In the same place.
Id. *Idem*, the same, *i. e.* *id est*, that is.
I. H. S. *Iesus Hominum Salvator*, Jesus the Saviour of men.
Jan. January.
J. D. *Juris Doctor*, Doctor of Law.
J. U. D. *Juris utriusque Doctor*, Doctor of both Laws, that is, of the civil and canon Law.
J. R. *Jacobus Rex*, King James.
Jul. July, Julius.
K. King.

<i>Knt.</i> Knight.	fessor of Divinity in Gresham College.
<i>L. Liber</i> , a book; <i>Libra</i> , a pound sterling.	<i>P. S.</i> Postscript.
<i>lb.</i> a pound weight.	<i>Q.</i> Queen, or Question.
<i>Ld.</i> Lord.	<i>q. quadrans</i> , a farthing.
<i>L. J. C.</i> Lord Chief Justice.	<i>q. d. quasi dicat</i> , as if he should say.
<i>L. L. D. Legum Doctor</i> ; Doctor of Laws.	<i>q. l. quantum libet</i> , as much as you please.
<i>L. S. Locus Sigilli</i> , the place of the seal in writings.	<i>q. s. quantum sufficit</i> , a sufficient quantity.
<i>M. A.</i> Master of Arts.	<i>R. Rex</i> , King; <i>Regina</i> , Queen.
<i>Mar.</i> March.	<i>R. P. Regius Professor</i> , King's Professor.
<i>M. D. Medicinæ Doctor</i> , Doctor of Physic.	<i>R. S. S. Regiæ Societatis Socius</i> , Fellow of the Royal Society.
<i>Mr.</i> Master.	<i>S. or St.</i> Saint.
<i>Mrs.</i> Mistress.	<i>S. Solidus</i> , a shilling.
<i>M. S.</i> Manuscript.	<i>S. A. Secundum artem</i> , according to Art.
<i>M. S. S.</i> Manuscripts.	<i>S. N. Secundum Naturam</i> , according to Nature.
<i>M. S. Memorizæ Sacrum</i> , Sacred to the Memory.	<i>S. T. P. or S. S. T. P. Sanctæ or Sacra Sanctæ Theologiæ Professor</i> , Professor of Divinity.
<i>N. B. Nota Bene</i> , Mark well.	<i>Sep. or 7ber.</i> September.
<i>N. S.</i> New Stile.	<i>V. D. M. Verbi Dei</i> (or <i>Divini</i>) Minister, a preacher of God's word.
<i>Nov. or 9ber.</i> November.	<i>v. vide</i> , see.
<i>O. S.</i> Old Stile.	<i>viz. videlicet</i> , to wit, or that is.
<i>Oct. or 8ber.</i> October.	<i>Ec. et cetera</i> , and the rest, or, and so forth.
<i>Oz</i> Ounce.	
<i>p. per</i> , by.	
<i>Per cent. Per centum</i> , by the hundred.	
<i>P. M. G.</i> Professor of Music in Gresham College.	
<i>Prof. Th. Gr. Professor Theologiæ Greshamensis</i> , Professor of Divinity in Gresham College.	

There are many other abbreviations used, and frequently without any propriety, and merely according to the caprice of the writer. It may be observed, however, that the best writers use the fewest abbreviations. Some abbreviations contain a great number of letters

letters, especially in inscriptions upon coins and medals. The inscription upon our own coin runs thus: Georgius III. Dei Gratia, M. B. F. Et H. Rex. F. D. B. Et L. D. S. R. I. A. T. Et E. That is *Georgius Tertius, Dei Gratia, Magnæ Britannia, Franciæ, & Hiberniæ Rex, Fidei Defensor, Brunswicii & Lunenburgi Dux, Sacri Romani Imperii Archi-Thesaurarius & Elector*. George the Third, by the grace of God, King of Great Britain, France and Ireland, Defender of the Faith, Duke of Brunswick and Lunenburg, Arch-treasurer and Elector of the Holy Roman Empire.

OF NUMBERS AND FIGURES.

Numbers are expressed either by these seven Roman Capital Letters, I. V. X. L. C. D. M. which are called *Numerals*; or by these ten characters, viz. 1, 2, 3, 4, 5, 6, 7, 8, 9, which are called *figures*, and 0, which is a *cypher*.

I. signifies One. V. Five. X. Ten. L. Fifty. C. a Hundred. D. Five Hundred. M. a Thousand. 1. signifies one. 2. two. 3. three. 4. four. 5. five. 6. six. 7. seven. 8. eight. 9. nine. 0. nothing.

If a less *numeral letter* be placed before a greater, it takes away from the greater as many as the less one stands for; but if it be placed after a greater, it adds to it as many as the less one represents. Thus, the letter V. stands for *Five*. I placed before it takes *one* from it, and makes both together stand but for *Four*; as IV. But I. placed after the V. adds *one* to it, and makes both together stand for *Six*; as VI. Here follow some more examples.

IV. Four.	V. Five.	VI. Six.
IX. Nine.	X. Ten.	XI. Eleven.
XL. Forty.	L. Fifty.	LX. Sixty.
XC. Ninety.	C. a hundred.	CX. a hund. and ten.

Cyphers on the right hand of *Figures* increase their value ten times; 1 One, 10 Ten, 100 a Hundred, 400 Four Hundred, 8,000 Eight Thousand. But on the left

left hand, they signify nothing ; as 03, 003, make but *Three*, 06, 006, 0006, make but *Six*.

A *Figure* at every remove from the right hand en-
creases its value *ten times* ; as 4 *Four*, 45 *Forty-Five*,
456 *Four Hundred and Fifty Six*, 4567 *Four Thousand*
Five Hundred and Sixty Seven. I shall here give a
more complete example of the use of *Numeral Letters*
and *Figures*.

FIGURES.

NUMERAL LETTERS.

1. One
2. Two
3. Three
4. Four
5. Five
6. Six
7. Seven
8. Eight
9. Nine
10. Ten
11. Eleven
12. Twelve
13. Thirteen
14. Fourteen
15. Fifteen
16. Sixteen
17. Seventeen
18. Eighteen
19. Nineteen
20. Twenty
21. Twenty-one
22. Twenty-two
23. Twenty-three
24. Twenty-four
25. Twenty-five
26. Twenty-six
27. Twenty-seven
28. Twenty-eight
29. Twenty-nine
30. Thirty
40. Forty
50. Fifty

- I.
- II.
- III.
- IV.
- V.
- VI.
- VII.
- VIII.
- IX.
- X.
- XI.
- XII.
- XIII.
- XIV.
- XV.
- XVI.
- XVII.
- XVIII.
- XIX.
- XX.
- XXI.
- XXII.
- XXIII.
- XXIV.
- XXV.
- XXVI.
- XXVII.
- XXVIII.
- XXIX.
- XXX.
- XL.
- L.

60. Sixty

FIGURES.

NUMERAL LETTERS.

60. Sixty.	LX.
70. Seventy	LXX.
80. Eighty	LXXX.
90. Ninety.	XC.
100. One Hundred	C.
200. Two Hundred	CC.
300. Three Hundred	CCC.
400. Four Hundred	CCCC.
500. Five Hundred	D or 10
600. Six Hundred	DC or 10C
700. Seven Hundred	DCC or 10CC
800. Eight Hundred.	DCCC or 10CCC
900. Nine Hundred.	DCCCC or 10CCCC
1000. One Thousand.	M. or D10
1780. One Thousand Seven Hundred and eighty.	MDCCLXXX.

DIRECTIONS FOR SUPERSCRIBING LETTERS and ADDRESSING PERSONS of DIFFERENT RANKS and CONDITIONS.

SUPERSCRPTION.

ADDRESS.

To the ROYAL FAMILY.

To the King; or to the King's most excellent Majesty.	} Sir; or, May it please your Majesty.
To his Royal Highness, the Prince of <i>Wales</i> .	
	} Sir; or, May it please your Royal Highness.

In the same Manner to any other branch of the Royal Family, altering only the Superscription and Address, according to the difference of title and sex.

To the NOBILITY.

To his Grace B. Duke of C——	} My Lord Duke, Your Grace.
To the most noble D. Marquis of E.	
	} My Lord Marquis, Your Lordship.

To

To the Rt. Hon. F.

Earl of G.

To the Rt. Hon. H.

Lord Viscount J.

To the Rt. Hon. K.

Lord L.

} My Lord,
Your Lordship.

The Ladies are addressed according to the rank of their husbands.

All the sons of Dukes and Marquisses, and the eldest sons of Earls, have, by the courtesy of England, the title of *Lord* and *Rt. Hon.*

The eldest son of a Duke, a Marquis, or an Earl, is likewise commonly distinguished by the second title of his father.

The younger sons of Earls, and all sons of Viscounts and Barons, are stiled *Honourable*, and are *Esquires*; as

To the Hon. M. N. Esq; Sir.

All the daughters of Dukes, Marquisses, and Earls are *Ladies*. All the daughters of Viscounts and Barons are honourable; as,

To the Hon. R. S. Madam.

The title of *Right Honourable* is given to all Privy Counsellors, to the Lord Mayors of London, York, and Dublin, and to the Lord Provost of Edinburgh.

All persons bearing the King's commission, are stiled *Honourable*; and every servant to the King on the civil or military list, or to any of the Royal Family, is stiled *Esquire*.

To the PARLIAMENT.

To the Rt. Hon. the Lords } My Lords,
Spiritual and Temporal, in Parliament assembled. } May it please your Lordships.

To the Rt. Hon. the } Gentlemen,
Knights, Citizens and } May it please your
Burgesses, in Parliament assembled. } Honours.

To

To the Rt. Hon. C. D. }
 Esq; speaker of the } Sir.
 House of Commons.

To the CLERGY.

To the most Reverend Fa- } My Lord,
 ther in God B. Lord } Your Grace.
 Archbishop of C. }
 To the Rt. Reverend Fa- } My Lord,
 ther in God F. Lord } Your Lordship.
 Bishop of L. }
 The Rev. B. C. D. D. } Rev. Doctor.
 Dean of G. or Arch- } Mr. Dean.
 deacon, Chancellor, or } Rev. Sir.
 Prebendary of W.

All Rectors, Vicars, Curates, Lecturers, and Clergymen of other inferior denominations, are stiled *Reverend*.

The Officers of his Majesty's household are addressed either according to their rank and quality, or according to the nature of their office.

The Commissioners of the Civil List are addressed according to their rank, and are stiled *Right Honourable*; as

To the Right Hon. the Lords Commissioners of the Treasury, of the Admiralty, of Trade and Plantations, &c. Your Lordships.

The Commissioners of the Customs, Excise, Stamp-duty, Salt-duty, Navy, &c. are stiled *Honourable*; and if any of them are Privy Counsellors, they are stiled collectively *Right Honourable*—Sirs, your Honours.

In the army, all noblemen are stiled according to their rank, with the addition of their employment.

All Colonels were formerly stiled *Honourable*; as The Honourable G. H. but this method of addressing them is now grown obsolete. They are commonly addressed by their names only; as Colonel C. D. All inferior officers have the name of their employment set before their real name; as Major F. G. Captain L. M. &c.

In the navy, all noblemen are stiled according to their quality and office; and all admirals, who are not peers,

peers, are stiled *Honourable*. The other officers as in the army.

All Ambassadors have the title of *Excellency* added to their quality; as have all Plenipotentiaries and Governors abroad, and the Lords Justices of Ireland.

All Judges, if Privy Counsellors, are stiled *Right Honourable*; if not, they are stiled *Honourable*; as,

To the Right Honourable C. P. Lord Chancellor.

To the Right Honourable Sir E. W. Lord Chief Justice.

To the Honourable L. M. Esq; Lord Chief Baron.

To the Honourable R. S. Esq; one of the Justices of &c.

All other Gentlemen of the Law are stiled according to their rank and office; every Barrister having the title of *Esquire* given him.

All Gentlemen in the commission of the Peace have the title of *Esquire* and *Worshipful*; as have all Sheriffs and Recorders.

The Aldermen and Recorder of London are stiled *Right Worshipful*; as are all Mayors of Corporations, except Lord Mayors.

The Governors of hospitals, colleges, &c. if consisting of magistrates, or having any such among them, are stiled *Right Worshipful*, or *Worshipful*, as their titles may be. Incorporated bodies are called *Honourable*, as

To the Honourable Court of Directors of the East India Company. } Gentlemen,
Your Honours.

To the Honourable the Governor, Deputy-Governor, and Directors of the Bank of England. } Gentlemen,
Your Honours.

Sometimes they are called *Worshipful*; as,

To the Master and Wardens of the Worshipful Company of Drapers. } Gentlemen,
Your Worships.

The Wife of a Knight or Baronet is commonly distinguished by the title of *Lady*, and every Gentleman of an independent fortune by that of *Esquire*.

LETTERS ON VARIOUS OCCASIONS.

From a Father to his Son, lately entered into his Apprenticeship.

DEAR SON,

AS you have now been some time in your present situation, you must have had some experience of the nature of your business, which, I hope, you find equally consistent with your health, and agreeable to your inclination. It is a business, in which many a man has made a considerable fortune. Your master began the world, with as little fortune as you have yourself; and yet he is now in a very flourishing way. And indeed I think myself greatly obliged to him for taking you without any fee or premium; the rather, as I am well assured, that he has had very considerable premiums with some of his other apprentices. This deficiency on your part (for it is certainly a great deficiency) you must endeavour to make up by superior diligence and attention to his interest. This will not only be a proof of your gratitude, and endear you to your master; but it will be attended with the most beneficial consequences to yourself. It will render you, more speedily, a complete master of your business; and will give you, when you are out of your time, a much better chance of succeeding in the world, than those who have paid the highest 'prentice fees. Nor is this any thing new or uncommon: for I have known some apprentices, who were taken without premiums, and almost upon charity, become, by their diligence, so expert in their business, and others, who had paid the highest premiums, remain, through their negligence, so entirely ignorant of it, that, when they had finished their time, their masters would rather give thirty pounds a year to the one, than thirty shillings to the other. But,
in

in order to give you this favourable chance, you must endeavour to behave, during your whole apprenticeship, with the utmost diligence and sobriety; you must endeavour to make your business your pleasure: if you do not, you can never succeed in it; for whatever is done with constraint, can never be done well: and if at any time your master gives you a holiday, you must take care to spend it in the company of those of your own character, not in that of the profligate and abandoned. Bad company, indeed, is the ruin of most young people; and therefore you must shun it with the greatest care; for, as you have read in your Bible, "evil communication corrupts good manners:" and if you would know what bad company is, you may always be sure, that those are bad young men, who prefer their own pleasure and amusement to their master's business, and spend every hour they can spare, or more properly steal, from their necessary occupation, in taverns, play-houses, and other places frequented by the vicious and idle. Let me therefore entreat you to be constantly on your guard against the company of such people, and if at any time you are desired to join in their parties, your answer is ready, that your master's business will not admit of your neglecting it so long. Your master, indeed, is one of the best men, and your mistress one of the best women I ever knew; and I am sure it will not be their fault if you do not live happy. Your brothers and sisters join in their love to you, as does your mother with me in sending you our blessing. I shall be glad to hear from you as soon as convenient, and in the mean time am,

Your affectionate Father,

A. B.

From a Son to his Father, in answer to the above.

HONOURED SIR,

I Received your kind letter, and am greatly obliged to you for the good advice you give me, which I shall make it my constant study punctually to follow.

E

Indeed,

Indeed, I have very little temptation to deviate from my duty; for all my fellow-apprentices, as well as the clerks and journeymen, are so remarkable for their diligence and sobriety, that I must either have a very weak head, or a very bad heart, to be greatly deficient in either of these good qualities. The fact is, that our master sets us so good an example by a constant attendance upon his business, that, if we had no other motive, shame alone must restrain us from idling away our time, while he is husbanding his with the greatest œconomy. The opinion you entertain of my master and mistress is extremely well founded. The one behaves to me so like a father, and the other so like a mother, that, excepting the circumstance of my being obliged to attend to business a little more closely than formerly, I do not perceive any difference between my present situation and that which I was in, when under your own roof. With my love to my brothers and sisters, and my duty to my mother and you, I am,

Your obliged and obedient Son,

C. D.

From a Father to his Son, just entered into the service of a Gentleman.

DEAR SON,

NOTHING but my good opinion of your master's moral character could ever have induced me to consent to your entering into the sphere of life, in which you are now engaged. You will, no doubt, think yourself highly honoured by being admitted into the service of a gentleman of so much consequence as your master. Nor am I so proud as to think it any discredit to you; but neither am I, at the same time, so weak as not to foresee, that, in your present situation, you will have a much worse chance of gaining an establishment in the world, than if you had entered into the service of a farmer or tradesman. In the latter case you would have learned a trade or

pro-

profession, and when you had scraped together a little money of your own, you might have set up in business for yourself. But, in your present situation, you will learn no trade but that of a gentleman; and a gentleman, without a fortune to support his rank, is of all trades the most wretched and miserable, if it be not rather a gross impropriety of speech to call it a trade at all. You have, indeed, one prospect of getting a provision for life, and that is, that after you have served your master a number of years, with equal diligence and fidelity, he may perhaps be so good as to procure you some little place in the excise, the customs, or some of the other public offices; and this, I believe, is the most usual way of gentlemen's rewarding their old and faithful servants. But, in order to entitle you to this mark of his favour, you must first endeavour to deserve it by an unwearied attention to his interest. Never suffer any of his property to be wasted or embezzled, but study the preservation of it, as if it were your own. This cannot fail to endear you to your master, and render you a real blessing to him; for nothing can be a greater blessing to any man than a good servant, as, on the other hand, nothing can be a greater curse than a bad one. And to qualify you the better for discharging your duty in this faithful and conscientious manner, let me advise you to be constantly on your guard against the two vices, into which people in your way are most apt to fall: The vices I mean are idleness and extravagance. As you must have a great deal of leisure time, you should take care to spend it, not in card-playing, which is but too common a practice in great families; nor yet in fiddling, which is likewise very common among gentlemen's servants, and which, though not so irrational an amusement as the former, is yet a very trifling one: but you should employ all the time you can spare from your necessary business, in improving yourself in writing, arithmetic, and the practical parts of the mathematicks, such as gauging, mensuration, land-surveying, and the like, which will not only be of great service to you in your present situation, but will be still more useful when you come to get some little

likelihood of your own. As to extravagance, I have sufficiently cautioned you against that in advising you to be careful of your master's property. This indeed is a vice, to which the servants of great families are very generally subject. Surrounded, as they perpetually are, not only with the necessities and conveniencies, but even with the luxuries and superfluities of life, they think that as the source, whence all this plenty proceeds, has never been exhausted, it is altogether inexhaustible; and thus they waste, and squander, and consume, as if there were no end of their master's fortune. But, in order to cure them of this vicious and destructive habit, I would have them to reflect on the scanty fare which many of them had in their father's houses. There, they well know, that, instead of the luxuries and superfluities, they had not frequently the conveniencies, and sometimes hardly even the necessities of life. Let me, therefore, entreat you, my dear son, to avoid these two vices with the greatest care, and if you do, you cannot fail of being a good servant; which that you may, is the sincere wish of

Your affectionate Father,

F. G.

From a Son to his Father, in answer to the foregoing.

HONOURED SIR,

YOUR account of the manner in which gentlemen's servants usually spend their time, is so just, and agreeable to truth, that one would almost imagine you had been in that station yourself, tho' I well know you never was. They are, for the most part, so idle and extravagant, that one would be almost tempted to think they had nothing else to do than to squander away their master's property. There are, however, a few exceptions to this general rule; and I hope I shall always make one of this small,

small, but honourable number. Indeed, unless I and my fellow-servants were of a very wicked and abandoned disposition, we could not well be guilty of either of the vices you mention, as our master sets us an example of the contrary virtues. He is so far from being idle, that he spends all his time (except what is necessary for recreation) either in reading, or writing, in looking into his accounts, or in conversation with a few select friends: and though his table is plentifully, and even luxuriously covered, yet there is no waste or extravagance; but whatever remains, after the family is satisfied, is all given to some poor families; in the neighbourhood. I shall endeavour to perfect myself in the different branches of learning you mention, that so, if my master should be good enough to procure me a place, I may be able to discharge the duties of it in a proper manner. If not, I shall think it no hardship or disgrace to return into the country, and pursue a life of honest labour and industry, as you have done before me. With my duty to my mother and you, and my love to my brothers and sisters, I am,

Dear Father,
Your obliged and obedient Son,

H. G.

From a Father to his Son, just beginning the World.

DEAR SON,

AS you are now entered into business for yourself, I shall here endeavour to give you the best advice and directions I can for the proper conduct and management of your affairs. In the first place, then, you will observe, that diligence and application is the very life and soul of all kinds of business. He that attends to his business only by fits and starts, will never manage it well. Part of it will be entirely neglected, and even what is done, will be executed in so careless and slovenly a manner, that it had almost as well not be done at all. Method and

regularity are no less necessary. By assigning certain portions of time for the discharge of each particular part of your business, and by finishing each within the time allotted, you will perform more real business in one day, than you could otherwise do in two.

These things will not only be useful so far as they relate to yourself, but likewise as they relate to your servants. By setting them a good example, you will induce them to perform their duty with greater spirit and alacrity. Convince them that all your commands are founded in reason, and that you require nothing from them, but what you yourself would cheerfully do, were you in their situation and they in yours. By these means you will bring them to serve you, not from a principle of fear, which is seldom productive of any good effect, but from a principle of love, which is always productive of the best. By treating them, not as slaves, but as humble friends, you will induce them to consider you, not as an imperious tyrant, but a kind and benevolent master, whose interest, therefore, they will be as studious to promote, as if it were their own.

Another thing to be attended to, is the choice of your friends and bosom companions; those whom you would wish to consult on every trying and critical occasion. But here the greatest care and caution will be necessary; for a mistake in this particular may in time be followed by the most fatal effects. It will, therefore, be proper for you to form a judgment of those, whom you want to make your friends and advisers, by the conduct they have observed in their own affairs, and the reputation they bear in the world. For he who has, by his own indiscretion, ruined himself, is much fitter to be set up as a sea-mark to warn others to shun his courses, than as an example to be imitated. Old age is generally slow and heavy; youth headstrong and precipitate: but there are old men, who are full of vivacity, and young men replete with discretion. You should, therefore, be more careful in considering the conduct than the age

age of the persons, with whom you intend to associate; though, I must own, it appears to me a certain sign of prudence and virtue in a young man, when the aged are pleased with his company, and he delights in theirs. Let it, therefore, be your constant endeavour to connect yourself with men of sobriety, good sense, and virtue; for the old proverb is certainly true, which says, "that a man is known by his company." If you can single out such men from the mass of your acquaintance, you will at once improve by their conversation, and profit by their advice. But be sure always to remember this maxim, that though you must be free and unreserved in delivering your sentiments when occasion requires, yet you should be much readier to hear than to speak, as indeed all wise men are; and here it was well observed by one of the ancients, that nature has given man two ears, and but one tongue. Lay up, therefore, by prudent observation and modest silence, such a stock of knowledge in your early years; that, when you advance in life, you may make as respectable a figure as your seniors now do; and endeavour to profit by the misfortunes of others, rather than by your own. A silent youth generally makes a wise old man, and never fails to meet with respect from those of a sound and solid judgment.

When, therefore, you happen to be in the company of strangers, let every one speak before you deliver your sentiments; for by this means you will be able to judge of the character and capacity of those who are present, and, at the same time, will avoid them any mortifications, to which the forward are almost always subject. By carefully observing these maxims, and such others as your own prudence will suggest to you, you cannot well fail of succeeding in the world; and that you may do so, is the sincere wish of

Your affectionate father,

J. K.

From

From a Servant, in his Master's absence, to one of his country customers.

SIR,

MY Master happened to be from home when your letter arrived, and as your order would admit of no delay, I have endeavoured to execute it in the best manner I could. I know my master has a great regard for you, looks upon you as one of his best customers, and always expresses the strongest desire to oblige you: and, as his faithful servant, I have done my utmost to give you satisfaction, and am

Your most humble servant,

L. M.

DIRECTIONS for learning to Write without the help of a Master.

WRITING will never look well without a due proportion of the characters throughout the whole, a just distance between the letters themselves as well as the words, a natural inclination of one letter to another, and a smooth stroke perform'd with boldness and freedom.

The proportion of letters is regulated by the O and N; therefore practise them first in a large character.

Make all your body-strokes with the full, and all hair-strokes with the corner of your pen.

Never turn your pen, nor alter the position of your hand.

Let your hair-strokes be proportioned to your body-strokes, and answer one another.

Your letters without stems must be even at the top and bottom.

Let your stems above be equal in length to / (t only excepted.)

Your

Your stems below must be equal in length to y .

Let your capitals be equal in height to l , and a little stronger.

Let your words stand twice the distance of your letters, and your lines twice the length of l , that no stems may interfere.

Hold your pen between the two fore-fingers extended almost strait, and the thumb bending outward with the hollow downwards, and the nib flat.

Let your paper lie directly before you, and your hand rest only on the top of your little finger.

Rest your arm lightly between the wrist and the elbow.

Keep your body upright, and your elbow almost close to your side.

Rest your body on your left arm, and keep your paper down with your left hand.

Never lean hard on your paper.

In order to be able to write expeditiously in time, write slow at first.

Make the nib of your pen for the round and round-text hands, the breadth of the full-stroke, and that part lying next the hand, somewhat shorter and narrower.

For the *Italian* hand make the nib somewhat finer, and the slit longer.

Note, In writing where figures are intermixed, they must always slope.

Your figures likewise must be larger than your writing.

When your figures are ranged in columns, make them upright.

How to make a PEN.

TAKE the first, second or third quills in the wing of a goose or raven, (those that are round and clean are the best :) when you have scraped off the thin rind thereof with the back edge of your pen-knife, hold it in your left hand with the feather end

end from you, then enter the back thereof sloping, and cut off as much in length, as the quill is in breadth, and answer that with another cut on the inside, like and opposite to the former; then turn the quill and enter the edge of your pen-knife even in the back thereof, and exactly in the midst of the half-round, neither inclining the blade one way nor other, that the slit may not be made awry. Then put in the peg of your knife-haft, if it has one for that purpose, or the end of a whole quill, and with a sudden twitch force up the slit, holding your left-hand thumb hard upon the back of the quill, to fix how far the slit shall go. This being done, enter your knife sloping in the other side above the slit, about twice the breadth of the quill, and cut away the cradle piece; then turn the back upwards, and cut down to the end of the slit the cheek or shoulder-pieces, and in so doing turn the sharp edge of your knife a little inward towards the slit. After this, place the inside of the end or nib of the pen upon the nail of your left-hand thumb, holding the quill fast between the fore and middle finger of that hand. *Lastly*, To finish the nib, enter the edge of the knife on the back, and near the end thereof sloping, and immediately turning the edge almost downright, cut it off.

There are four things to be observed with regard to the Quill.

1. If the quill be too hard, steep it a while in water.
2. If it be too soft, harden it in embers.
3. If it be too thick, pare a small quantity from the back of the nib.
4. If it be too thin and weak, strengthen the pen with a short slit, a short nib, and a broad shoulder.

Materials for Writing.

A pen-knife razor-metal, quills good store;
Gum Sandric powder, to pounce paper o'er;

Ink

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Ink shining black, paper more white than snow,
Round and flat rulers on yourself bestow;
Small compasses to rule your double lines,
Wax, sand, and black-lead pens for your designs;
These, with a willing mind, and ready hand,
Will make this art your servant at command.

A Receipt for good BLACK INK.

TO six quarts of rain or river water, (but rain-water is the best) put one pound and a half of fresh blue galls of *Aleppo* (for those of *Smyrna* are not strong enough) bruised pretty small: eight ounces of copperas, clean, rocky, and green; also eight ounces of clean, bright, and clear gum arabic; and two ounces of rock allum: Let these stand together in a large stone bottle, clean stone pot, or earthen pot, with a narrow mouth to keep it free from dust; shake, roll, or stir it well once every day, and you will have an excellent ink in about a month's time, and the older it grows the better it will be for use.

Ingredients for a Quart.

One quart of water, four ounces of galls, two ounces of copperas, and two ounces of gum, mixed and stirred as above.

☞ If you soak the green peelings of walnuts, (at the time of the year when pretty ripe) and oak sawdust, or small chips of it, in rain-water, and stir it pretty often for a fortnight, and then strain it, and add the same ingredients as above, the ink will be stronger and better.

The above is the common method of making *Writing-Ink*, and will be sufficient for common occasions; but the following composition will produce an ink vastly superior, though attended with but little more expence and trouble than that given above.

A Rec.

*A Receipt for making the most perfect BLACK INK
yet known.*

TAKE a gallon of soft water, and boil it in a pound of Logwood chips for one hour. Take the decoction from the fire, and pour it from the chips, while boiling hot, upon a pound of *Aleppo* galls, beaten to powder, and two ounces of pomegranate peels, in a proper vessel. After stirring them well together with a stick, place them at a small distance from the fire, or, if in summer, in the sunshine, for three or four days, stirring the mixture often. At the end of that time add half a pound of green vitriol powdered; and let the mixture remain four or five days longer, taking care to stir it frequently; and then add farther four ounces of gum Arabic dissolved in a quart of boiling water; and after allowing the ink a proper time to settle, strain it off from the dregs through a coarse linen cloth; and keep it well stopt for use.

If the ink is desired to shine more, the proportion of gum Arabic must be increased.

How to make RED INK.

TAKE three pints of vinegar, and four ounces of ground Brazil wood; simmer them together for an hour; then put in four ounces of rock allum, and one ounce of gum Arabic; and simmer these together for half an hour, and then strain it through a flannel; bottle it up, well stopt, for use.

Or, you may dissolve half an ounce of gum Arabic in half a pint of water; then put a pennyworth of vermilion into a small gallipot, and pour some of the gum-water upon it, stir it well, and mix it together, with a hair pencil, to a proper consistency: It will not incorporate presently, but by the next day it will; then having a clean pen, dip it into the ink, having first well stirred it with the pencil; and then you may use it. It is a fine and curious red, though it

It does not flow so freely as the other. And after the same manner, you may make any other coloured ink, as blue, green, yellow, purple, &c. having divers gallipots for that use. In like manner you may mix the shell gold for curious occasions, pouring two or three drops, according to discretion, into the shell, and mix it well with a clean hair pencil, and with it put a little into a clean pen, &c. The small shells may be bought at some fan-painters, two or three for two-pence; or the large ones, (which are the best) at the colour-shops, at six-pence a piece.

To keep INK from Freezing or Moulding.

IN hard frosty weather, ink will be apt to freeze; which if once it doth, it will be good for nothing; for it takes away all its blackness and beauty: To prevent which, (if you have not the conveniency of keeping it warm, or from the cold) put a few drops of brandy, or other spirits into it, and it will not freeze. And, to hinder its moulding, put a little salt therein.

Single Line COPIES in PROSE, in Alphabetical Order.

A.

APPROVE not of that man who commends all you say.

Ask not that question you can resolve yourself.

A sense of our ignorance is the first step to knowledge.

Adversity is the touch-stone of friendship.

Affect rather to be useful than popular.

A flattering companion is a dangerous enemy.

A wise man's anger is of short continuance.

Accept no preferment on dishonourable terms.

Affirm not all you hear, nor speak all you know.

A true friend, like a glow-worm, shines in the dark.

A wise man governs with ease, and is obeyed with pleasure.

F

A prudent

A prudent woman sweetens her husband's misfortunes.
 Abundance and plenty make prodigals dainty.
 A covetous man is always in want.
 Add to your faith virtue, and to virtue knowledge.
 A comely countenance is a silent commendation.
 A place of ill example may endanger a good man.
 A prudent man values content more than riches.
 A virtuous mind is rather to be chosen than promotion.
 A fair piece of writing is a sort of speaking picture.
 Authority is the main point of government.
 A great liar is seldom believed, though he speaks truth.
 A wise man will hear, and will increase learning.
 Abstain from all appearance of evil.
 A merry heart maketh a chearful countenance.
 A false balance is an abomination to the Lord.
 Anger resteth in the bosom of fools.
 A soft answer turneth away wrath.
 A wise son heareth his father's instructions.
 A fool uttereth all his mind.
 Adversity makes a man wise, rather than riches.
 A gift long waited for is bought, not given.
 Advice comes too late, when a thing is done.
 A bribe will enter without knocking.

B.

BEfore you attempt consider whether you can perform.
 Bad books are the public fountains of vice.
 Be slow in chusing a friend; slower, in changing him.
 Be not desirous to know other men's secrets.
 Be more afraid of secret sins than open shame.
 Bounty is more commended than imitated.
 Brave spirits promote the public good.
 Be patient in adversity, and humble in prosperity.
 Beauty without virtue is like a painted sepulchre.
 Be ashamed of your pride, not proud of your shame.
 Be less confident, and more diligent.
 By learning to obey you shall know how to command.
 Beauty commands some, but money all men.
 Brave men will do nothing unbecoming themselves.
 By a commendable deportment we gain reputation.
 By diligence and industry we come to preferment.
 Be not thou one of them who are sureties for debts.
 Better

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Better is the end of a thing than the beginning.
Better to go to bed supperless, than to rise in debt.
Buying and selling is but winning and losing.
Better to be unmannerly, than too troublesome.

C.

Children require instruction, as well as provision.
Commit not that to another, which you can do yourself.

Custom in infancy becomes nature in old age.
Custom makes a person move like an engine.
Contemn not the poor, nor flatter the rich.
Charity should begin at home, and end abroad.
Chide him not too much who confesses his fault.
Conceal your weakness from them you instruct.
Compassionate men never prove extortioners.
Courtely and humility are marks of gentility.
Charity vaunteth not itself, is not puffed up.
Confession of a fault makes half amends for it.
Credit lost is like a broken glasse.
Contentment is preferable to riches and honour.
Consider the shortness of life, and certainty of death.
Competency with content is a great happiness.
Courtiers receive presents in the morning, and forget them by night.
Contentment makes a man happy without a fortune.

D.

Delight in what you undertake to learn.
Drinking is the drowning of cares, not the cure of them.

Delight and pleasure is but a golden dream.
Despair of cure is worse than the disease.
Delights, like physicians, leave us when dying.
Do unto others as you would have them do unto you.
Danger and adversity discover true friendship.
Death will comfortably end a well spent life.
Devise not evil against thy neighbour.
Do nothing through strife or vain-glory.
Deeds are the fruits, words are but leaves.
Distance is the best remedy against an evil man.

Drunkennes reveals what soberness conceals.
 Do no hurt, where you can do no good.
 Do not govern your life by fancy, but by reason.
 Delay in many cases is dangerous.

E.

Education is that which makes the man.
 Envy is always waiting where virtue flourishes.
 Envy, like a vulture, preyeth upon itself.
 Eat rather for appetite, than for pleasure.
 Esteem him who teacheth you wisdom.
 Every delay of repentance is a cheat upon ourselves.
 Envynot the sinner's glory, for thou knowest not his end.
 Exalt wisdom, and she shall promote thee.
 Even a child is known by his doings.
 Every purpose is established by counsel.
 Ease and honour are seldom bed-fellows.
 Every man's a pilot in a calm sea.
 Examples prevail, when arguments fail.
 Every sluggard is the cause of his own misfortune.
 Evil company makes the good bad, and the bad worse.
 Experience is the best looking-glass of wisdom.

F.

FAIR words are often a cloak for foul actions.
 Follow the dictates of reason, and you are safe.
 Follies past are sooner remembered than redress'd.
 Forget not God in your mirth, nor yourself in anger.
 Frequent commission of sin hardens men in it.
 First learn to obey before you pretend to govern.
 Fortune commonly favours the courageous.
 Feed your body as your slave, not as your master.
 Faults committed in public should be publicly reprov'd.
 Forsake the foolish, and go in the way of understanding.
 Faithful are the words of a friend.
 Fools make a mock at sin.
 Fools tie knots, wise men undo them.
 Fools may put somewhat in a wise man's head.
 Flee pleasure, and it will follow you.
 Few do good with what they have gotten ill.
 Future events must be left to Providence.

Fear

Fear is a good watchman, but a bad defender.
 Fraud in childhood will become knavery in manhood.
 Fear without hope turns to despair.
 Frugality and industry are the hands of fortune.

G.

GRIEF may shorten life as much as a disease.
 Goodness generally leads to universal esteem.
 Grieve not for those things which are out of your power.
 Great sins will require great repentance.
 Great receipts render men liable to great accounts.
 Great men have many opportunities to do much good.
 Give God the first and last of each day's thought.
 Good education is the foundation of man's happiness.
 Give as cheerfully as you receive.
 God often corrects us in this life, to save us in the next.
 God is our refuge, a very present help in trouble.
 God, our parents, and our masters, cannot be requited.
 Good manners, grace, and truth, are ornaments of youth.
 Great minds and small means ruin many men.
 God's works only are perfect in their kind.

H.

Happiness is desired by all, but obtained by few.
 He is in some degree wise that conceals his ignorance.
 Honours grace wise men, and make fools notorious.
 He that will not work should not eat.
 He that begins well, has half done the work.
 Hear both parties before you give judgment.
 He that boasts of his sins, glories in his shame.
 He that trusts a known knave, should expect to be cheated.
 He never wants comfort, that has content.
 He that delights to plant and set, puts after-ages in his debt.
 Hear instruction; be wise, and refuse it not.
 He that pitieth another, remembereth himself.
 Hasty resolutions are seldom fortunate.
 He that stumbles, and falls not, mends his pace.
 Hypocrites first cheat the world, and then themselves.
 He that sends a fool on an errand, ought to follow him.

He that sins against conscience, sins with a witness.
He that swims in sin, must sink in sorrow.

I.

Idleness has no advocate, but many friends.
It requires as much care to keep, as to get an estate.
Industry keeps the mind clear, and the body healthy.
In others forgive much, nothing thyself.
It is a double curse to be poor and proud.
In prosperity prepare for adversity.
Intemperance kills more than the sword.
It is a folly to fear, when we cannot avoid.
Ingratitude thinks itself in no man's debt.
If any man lack wisdom, let him ask it of God.
If riches increase, set not your heart upon them.
In the multitude of counsellors there is safety.
Industry is fortune's right-hand, and frugality her left.
Instruction and a good education is a durable portion.
It is good to have a friend, but bad to need him.
It is better to be unborn than untaught.
Improvement of parts is by improvement of time.
It is the work of an age to repair the miscarriages of
an hour.

K.

K Now when to speak, and when to hold your tongue.
Keep company with those who may make you
better.

Keep thy tongue a prisoner, that your body may go free.
Knowledge puffs up some men, and humbles others.
Knowledge is the treasure of the mind.
Keep thy tongue from evil, and thy lips from guile.
Keep good company, and you shall be of that number.
Knavery may serve a turn, but honesty's best at long
run.

Keep a close mouth, if you would have a wise head.

Kings, as well as mean men, must die.

Kings may command, and subjects must obey.

Keep at a distance from ill company.

Keep good decorum in your words and actions.

Kings may win crowns, but cannot conquer death:

Learning

L.

LEARNING is the rich man's ornament, and the poor man's riches.

Laziness is commonly punished with want.

Little sins commonly lead men to great evils.

Learning is the ornament of youth, and comfort of age.

Life and death are in the power of the tongue.

Lying lips are an abomination unto the Lord.

Let another man praise thee, and not thy own mouth.

Love not sleep, lest thou come to poverty.

Let your letter stay for the post, and not the post for your letter.

Liberty is grateful to all, but destructive to many.

Let no jest intrude upon good manners.

Lost opportunities are very rarely, if ever recovered.

Let not the work of to-day be put off till to-morrow.

Laugh not out of measure, nor out of season.

M.

MANY have suffered by over-talking, but few by silence.

Man has much to learn, but a short while to live.

Money is some men's servant, and other men's master.

Malice seldom wants a mark to shoot at.

Make not a jest of another man's infirmity.

Make provision for want in time of plenty.

My son, if sinners intice thee, consent thou not.

Mercy and truth shall follow them who devise good.

Make no friendship with an angry man.

My son, gather instruction from thy youth up.

Many things fall between the cup and the lip.

Mischiefs come by the pound, and go away by the ounce.

Make not thy friend cheap to thee, nor thyself to thy friend.

Monuments of learning are the most durable.

Many know good, but do not the good they know.

Measure not goodness by good words only.

Many live beggars all their life, that they may not die so.

Money makes some men mad, many merry, but few sad.

Many

Many are led by the ears, more than by the understanding.

Many are made faints on earth, that never reach heaven.

Mend your manners, and that will mend your fortune.

Many want help, that have not the face to ask it.

N.

NONE pretend to hate an injury more than he who offers it.

No torments are so great, but patience may vanquish.

Nothing is more contagious than an ill example.

Not to grow better is commonly to grow worse.

No man hath seen God at any time.

None are fools always, but every one sometimes.

No day passeth without some grief.

Neither praise nor dispraise yourself.

None should covet what cannot possibly be had.

Nothing is constant in this uncertain world.

Necessity is commonly the mother of invention.

Nothing is so hard, but diligence may overcome.

None can lay himself under an obligation to do ill.

Nature seldom changes with the climate.

O.

OF all prodigality, that of time is the worst.

Our life here is but a journey to the next World.

One vice is more expensive than ten virtues.

One fault cannot justify the commission of another.

One bad companion may ruin many good men.

Of all poverty, that of the mind is most deplorable.

Of all things, death should never be forgot.

Out of the abundance of the heart the mouth speaketh.

Only by pride cometh contention.

Open rebuke is better than secret hatred.

On a good bargain think twice.

One ounce of discretion is worth a pound of wit.

Once well done is twice done.

Opportunity neglected brings severe repentance.

On the present time depends our future state.

Our minds must be cultivated as well as our plants.

Other people's deaths should be memento's to our own.

Prosperity

UNIVERSAL COMPANION. 57

P.

Prosperity gains friends, and adversity tries them.
Punishment deferr'd commonly falls heavier.
Providence consults our wants, not our wantonness.
Passion is a bad counsellor, and as ill a speaker.
Pride, like a wild horse, overthrows his rider.
Pursue useful and profitable studies.
Poverty and shame attend those that refuse instruction.

Profess not to know what thou art ignorant of.
Pain is forgotten when gain follows.
Provide against the worst, and hope for the best.
Poor men want many things, but covetous men all.
Put not off the main business of life to the very article of death.
Pain we can count, but pleasure steals away.
Poor freedom is better than rich slavery.
Passion and partiality govern in too many cases.

Q.

Quantity is of less consequence than quality.
Quench not your desires when they tend to good.
Quarrels are easily begun, but ended with difficulty.
Quarrellsome persons are mischievous companions.
Quietness is secure, but rashness is dangerous.
Quick at meat, quick at work.
Quick promisers are slow performers.
Questions in jest need no serious answers.
Quietness and content are most excellent companions.
Quarrellsome persons sometimes meet with their match.

R.

Religion is best understood when most practised.
Revenge not injuries, but forgive them.
Reality is now become a great rarity.
Rather mistrust too soon, than be undeceived too late.
Revenge is a pleasure only to a mean spirit.
Repentance is the physic of the soul.
Rich men depend on the poor, as well as the poor on them.

Riches

58 THE YOUNG MAN'S

Riches profit not in the day of wrath.

Remember thy Creator in the days of thy youth.

Ride softly, that you may come home the sooner.

Rely not on another for what you can do yourself.

Remember your duty to God, your neighbour, and
yourself.

Repent to day; to-morrow may be too late.

Reputation is gained by many actions, and lost by
one.

Religion in hypocrites is, as it were, but skin deep.

Riches serve a wise man, and rule a fool.

S.

SELF-love is the greatest flatterer in the world.

Saying and doing should be but one man's office.

Silence is an antidote against an envious tongue.

Sin goes before, and shame certainly follows after.

Success does not always attend desert.

Shame and disgrace shall be the portion of fools.

Say not thou, I will recompense evil.

Separate thyself from thine enemies.

Speech is the picture of the mind.

Shew me a liar, and I will shew you a thief.

Sin and sorrow are inseparable companions.

Soft words sometimes work upon the proudest heart.

T.

THE power of example prevails more than precept.

Truth is ashamed of nothing but to be hid.

Travel makes a wise man better, and a fool worse.

Trust not too far, nor mistrust any too soon.

The hope of reward sweetens labour.

To praise yourself is the way to be dispraised.

To be cheated twice is once your fault.

They need much, whom nothing will content.

The greatest talkers are always the least doers.

The worth of a thing is best known by the want of it.

The doing nothing is very near doing Evil.

Truth is the strongest band of human society.

To do good is the way to find it.

Time, tide, and carriers, will for no man stay.

The unfortunatè is insulted by every rascal.

V. VICE

V.

VICE often deceives us under the colour of virtue.
 Value not yourself on other men's opinion.
 Variety is the beauty of the world.
 Virtue to noblest acts the mind inclines.
 Virtue often suffers, when vice goes unpunished.
 Value not so much a fine scabbard, as a good sword.
 Valour can do little without discretion.
 Undertake deliberately, but act vigorously.
 Unlawful love ends generally in bitterness.
 Unto the upright there arises light in darkness.
 Virtue is first to be sought for, and money the next.
 Virtue and fortune work wonders in the world.
 Virtue is commended of all, but followed by few.
 Virtue is seldom found a match for power.
 Unwillingly go to law, and willingly make an end.
 Understanding a thing is half doing it.
 Use soft words, and hard arguments.

W.

WHATEVER is forbid in act, is also in thought.
 Wicked practices discover bad principles.
 Would you be wise? endeavour to be good.
 Write injuries in dust, but kindnesses in marble.
 Wisdom to the mind is like health to the body.
 When passion rides, then give reason the rein.
 Wise men keep their expences short of their income.
 Where our treasure is, there will our hearts be also.
 Weight and measure take away strife.
 Where there is no fault, there needs no pardon.
 We keep a better account of our money than of our time.
 We must not blame fortune for our own faults.
 Would you be rich, be industrious; if wise, be studious.

X.

XENOPHON accounted the wise man happy.
 Xerxes wept at the changeable state of man.
 Xenophon commended heroic and virtuous exercises.
 Xenophon was a learned general.

Xenophon

60 THE YOUNG MAN'S

Xenophon was a great captain, as well as a philosopher.

Xerxes wept at the thought that his vast army would be dead in 100 years.

Xerxes whipt the sea, because it would not obey his command.

Xenocrates, though a philosopher, was very dull and heavy.

Y.

Youth is full of disorder, and age of infirmity.

Young men are prone to hearken to bad counsel.

You may know men by the company they keep.

You may be seen to give; but give not to be seen.

Your vice, and not your poverty, is your shame.

Young men, see that you honour the aged.

You must crack the shell before you can have the kernel.

Yield quietly to what must come unavoidably.

Young men in strength should provide against age and weakness.

Z.

ZEAL grounded on knowledge enlivens devotion.

Zeal for religion cannot warrant revenge.

Zoilus and Momus will be always carping.

Zeal, when misguided, proves mischievous.

Zeal, in a good cause, commands applause.

Zealously strive for an eternal crown.

Zeno was the first of the Stoic philosophers.

Zeal without knowledge is but religious wild-fire.

Zeal, if not rightly directed, is very pernicious.

Short lines for TEXT HAND.

Abandon whatsoever's ill. Care destroys the body.

Be wise betimes. Do the things that are just.

Expect to receive as you give. Recompense a good turn.

Frequent good company. Repent of your sins.

Give what you give cheerfully. Sin not wilfully.

Have good men in esteem. Time well improve.

Imitate that which is good. Turn from your sins.

Keep God's commandments. Use moderate pleasure.

Learn to be wise. Use not bad company.

Money

UNIVERSAL COMPANION. 61

Money answers all things. Vain are most pleasures.
Nothing get, nothing have. Wisdom is the principal
Observe modesty. thing.
Pleasures are very short. Wise men are scarce.
Pains are very long. Xenophon and Xenocrates.
Quit all revenge. Zeno and Zenobia.
Quiet your passions

COPIES in Verse Alphabetically digested.

A.

ALL human things are subject to decay;
And, when death summons, monarchs must obey.
Ape-like fond parents act extremely ill,
While with embraces, whom they love, they kill.
An honest man may take a knave's advice;
But idiots only will be cheated twice.

B.

BRAVE deeds and spotless virtue have
Rewards, which shall out-live the grave.
Brave minds oppress'd should, in despite of fate,
Look greatest like the sun in lowest state.
Be thou the first true merit to befriend:
His praise is lost, who stays till all commend.
By being fortune's friend, you shall have friends;
But in adversity their friendship ends.
See how the doves to new-built houses run,
And cautiously the ruin'd tower shun.
The empty barns no vermin ever haunt:
And no friend comes to him that is in want.

C.

Content is all we aim at with our store,
And having that with little need no more.
Custom's a cruel tyrant; he that can
Well bear, or break its force, its more than man.
Censure none rashly; nature's apt to halt:
Look inward: he's unborn that has no fault.

G

Children,

Children, like tender oziers, take the bow;
And, as they first are fashion'd, always grow.

D.

Daring ambition loves to slide, not stand;
And fortune's ice prefers to virtue's land.
Death comes too soon in gay and prosperous days;
But in our misery too long delays.
Delays are dangerous; take a friend's advice;
Begin, be bold, and venture to be wise.

E.

Example is a living law, whose sway
Men more than all the written laws obey.
Each good man is, in any place, at home;
The bad's an exile whereso'er he come.
Ears we have two, one tongue, from whence 'tis
clear,
Before we speak once, we ought twice to hear.
Envy will merit, like a shade, pursue;
But, like a shadow, proves the substance true.

F.

Fortune a goddess is to fools alone:
The wise are always masters of their own.
Friendship will not the least reserve endure;
But loves to share in griefs it cannot cure.
Fear timely comes before a fault's begun:
He fears too late, who fears not till 'tis done.

G.

Great wit to madness sure is near ally'd;
And thin partitions do their bounds divide.
Great wits, as well as warriors, only gain
Laurels and honours by their toil and pain.
Good nature and good sense must ever join;
To err is human, to forgive divine.

H.

HE who pays more respect to wealth than sense,
Would worship idols to increase his pence.

He

UNIVERSAL COMPANION. 63

He who bewails, and not forsakes his sin,
 Confesses only what he'll do again.
 He's rich, who never covets worldly pelf;
 He's poor, who has enough; yet starves himself.
 Honour and shame from no condition rise:
 Act well your part, there all the honour lies.

I.

IMmodeſt words admit of no defence:
 For want of decency is want of ſenſe.
 'Tis to detract to give one leſs than due;
 Who gives as much, muſt be as learned too.
 In all miſfortunes this advantage lies,
 They make us humble, and they make us wiſe.

K.

KNOW when to ſpeak, and ſilent when to fit;
 Fools ſilent often paſs for men of wit.
 Know then this truth, enough for man to know;
 Virtue alone is happineſs below.

L.

LIFE for delays and doubts no time does give;
 None ever yet made haſte enough to live.
 Leave God to manage for thee, and to grant
 What his unerring wiſdom ſees thee want.
 Laughter, if rightly us'd, may be confeſs'd,
 In ſome ſort, to diſtinguiſh man from beaſt;
 While by due management it is allay'd,
 And the ſtrict rules of reaſon are obey'd:
 But ſhews, if over loud, or over long,
 Your head's but weak, altho' your lungs be ſtrong.

M.

MEN are more oſt on earth than heaven intent,
 And their induſtrious ſearch is downwards bent.
 Marble, or braſs, devouring time may waſte;
 But wit, as long as circling time, ſhall laſt.

G 2

NONE

N.

NONE more pragmatical in state appear,
 Than they whose judgments in their pockets are.
 Next to the power of making tempests cease,
 Is, in a storm, to learn to be at peace.
 No minutes surely bring us more content,
 Than those in pleasing useful studies spent.

O.

OUR shoes and fortune sure are near ally'd :
 We limp in strait, and stumble in the wide :
 Observe in your discourse the bounds of reason :
 For sense proves nonsense, spoken out of season :
 Our yesterday's to-morrow now is gone,
 And still a new to-morrow does come on ;
 We by to-morrow draw up all our store,
 Till the exhausted well can yield no more.

P.

Presence of mind, and courage in distress,
 Are more than armies to procure success.
 Premeditate your speeches ; words once flown
 Are in the hearers power, not your own.
 Parts may be prais'd, good nature is ador'd ;
 Then draw your wit as seldom as your sword.

Q.

QUICKLY lay hold of time, while in your power ;
 Be careful well to husband every hour :
 For time shall come, when you shall sore lament
 Th' unhappy minutes which you have mispent.

R.

RICH men are not too rich, whom pride ne'er swells ;
 Nor poor men poorenough, in whom pride dwells.
 Riches, like insects, when conceal'd they lie,
 Wait but for wings, and in their season fly.

S.

SORROW and joy are ne'er disguis'd by art ;
 Our forehead shews the secrets of our heart.

Sicilian

Sicilian tyrants never yet could find
A greater torment than an envious mind.

T.

THE stupid world most honours pay to those
Who on their understanding most impose.
The world's a wood, in which most lose their way,
Though by a different path each goes astray.
Titles may set a gloss upon our name;
But virtue only is the life of fame.
'Tis with our judgments as our watches; no
Go just alike, yet each believes his own.

V.

VIEW all the habitable world, how few
Know their own good, or knowing it pursue!
Virtue must be the fashion of the town,
Before the beaux and ladies put it on.
Usurpers seldom to the shades descend,
By a dry death, or with a quiet end.
Virtue's the chiefest beauty of the mind,
The noblest ornament of human kind:
Virtue's our safeguard, and our leading star,
That guides our reason, when our senses err.

W.

WHY should we think of being others heirs?
Does not our sand run out as fast as theirs?
Who with their present state are not content,
May find a worse for their just punishment.
Want is a bitter and a hateful good,
Because its virtues are not understood:
Yet many things impossible to thought,
Have been by want to full perfection brought.

X.

XERXES survey'd his mighty host with tears,
To think they'd die within an hundred years;
But by his own ill management we see,
They're all destroy'd, and dead in less than three.

G 3

Xantippe

Xantippe brawls, while Socrates is still,
 Yet ne'er was quiet, though she had her will:
 Her fury made him patient, her perplex'd,
 That, when she rag'd, she could not make him vex'd.

Xerxes, as poets sing, a haughty brave,
 Whipt the rude winds, and made the sea his slave:
 But how return'd he, let us ask again?
 In a poor skiff he pass'd the bloody main,
 Choak'd with the slaughter'd bodies of his train. }

Y.

Yesterday's past, to-morrow's none of thine;
 To-day thy life to virtuous acts incline.

You parents, who your hopes in children place,
 Teach them betimes to run in virtue's race.

You'll mend your life to-morrow, still you cry:
 In what far country does this morrow lie?

Youth is unfit great matters to contrive,
 Their reason's weak, their judgment scarce alive.

Z.

ZEAL is a fire, and useful in its kind;
 But nothing is more dangerous, if blind.

Zaleucus made his laws so strict, that those,
 Who were adult'ers, both their eyes should lose.

Zeal for the public good with men is rare;
 But for self-interest, that's their chiefest care.

To write on Paper Gold Letters, called Shell Gold.

LAY a little leaf gold upon a fine earthen plate,
 and drop thereon a little clear virgin honey; then
 work it with your clean knife's haft, until it is stiff
 like paste, and put it into an oyster shell; when you
 are to write with it, put a little gum-water on the
 side of the gold, and mix a little thin, fit for your
 pen.

How to write secret Letters.

WRITE what you would have seen on one side
 of the paper with common ink, and the other
 side,

side, with milk, that which you would have secret; and, when you would make the same legible, direct your friend to hold that side, which is written with ink, to the fire, and the milky letters will shew bluish on the other side, and easy to be read.

Another Way.

RULE two papers of one bigness with lines at an equal distance, cut full of square holes, which being laid upon another sheet of paper, you may write your mind upon it through those holes, and fill up the spaces with other words, which ought to hang together in good sense, to prevent suspicion. Each person to whom you write, must have one of the cut papers to read your letters; and this way of writing cannot be read by any one else.

Another Way.

YOU may first write a letter, that may carry good sense, to your friend; but let the lines be wide asunder: Then between your lines write your secret letter, with gall-water only, wherein the galls have been infused but a little time; for if, after you have written with it, there be any sensible colour left on the paper, you must throw away the water, and make new; this being dry, and of one colour with the paper, will give no cause of suspicion; and the rather, because the letter carries a sufficient sense already. Now, for the discovery of it, you must dissolve some copperas in fair water, and with a fine pencil, dipt in the copperas-water, you must moisten the interlining of your letter, and thereby you will make it legible.

How to write with Blue and Red Letters at once, with the same Ink and Pen, and upon the same Paper.

PUT the quantity of a hazel-nut of Litmose-blue to three spoonfuls of conduit-water, wherein some gum-arabic is dissolved; and when it hath settled

settled the space of an hour, if you write therewith, you will have perfect blue letters: And if you dip a pencil in the juice of lemon, and wet some part of the paper therewith, and afterwards let your paper dry again, and then write upon the place where the joice of the lemon was laid. with your blue ink, the letters will suddenly become red, and in all the rest of the paper the letters will be blue.

FORMS OF WILLS, BONDS, INDENTURES, AND OTHER LEGAL DEEDS.

A Form of a Will, a man having no Children.

IN the name of God, Amen. I A. B. of ——— in the county of ———, grazier, being of sound and disposing mind and memory, do make and ordain this my last will and testament, in manner and form following: That is to say, First, I will, that all my debts and funeral charges be paid and discharged by my executrix herein after named. Also, I give and bequeath to my brother — of — the sum of fifty pounds of lawful money of *Great Britain*. Also, I do give and demise unto — my sister's son, all that cottage, or tenement, situate in the parish of — in the county of — now in the occupation of — with the close adjoining to it, to the said — his heirs and assigns for ever. Also, I do give unto — my loving wife all the rest of my goods and chattels, and personal estate whatsoever. Also, I do give and demise unto — my said wife, her heirs and assigns for ever, all my lands and tenements lying in the parish of — in the county of — and now in the several occupations of — and — or their under-tenants, and also the messuage or tenement, situate in the parish of — in the said town of — and now in my own occupation, together with the orchard, and all the appurtenances thereunto belonging. Lastly, I do make and constitute

tute ——— my said wife executrix of this my last will and testament. Dated this ——— Day of ———, in the year of our Lord, 1780.

A. B.

Note, There must be three witnesses to the above will, because there is a devise of lands.

Note, That a man may give his goods to any person by word of mouth, before three witnesses, before his death; but it is much safer to do it by deed of gift in writing, in some such form as the following:

A Deed of Gift of Goods.

TO all people unto whom this present writing shall come; I, C. D. of &c. send greeting: Know, ye, that I, the said C. D. for divers and good causes, and valuable considerations, me hereunto moving, have given and granted, and by these presents do give, grant, and confirm unto F. G. of &c. all and singular my goods, chattels, household-stuff, and all other my substance whatsoever, in whose hands, custody, possession, or keeping soever, the same are, or can, or may be found, to *have and to hold*, all and singular the said goods, chattels, and household-stuff whatsoever of me the said C. D. unto the said F. G. his executors, administrators and assigns, and from henceforth to his and their own proper use and uses thereof, and therewith to do, order and dispose, at his or their own wills and pleasure, as of their own proper goods and chattels, freely, and peaceably, and quietly, without any manner of lett, trouble, or denial of me the said C. D. or any other person or persons whatsoever: Of all which premises I the said C. D. have put the said F. G. in full and peaceable possession by virtue hereof. In witness whereof, I the said C. D. have hereunto set my hand and seal the 10th of *June*, 1780.

Sealed and delivered (being first legally stamped) in the presence of ———

A Codi-

*A Codicil, or Schedule to a Will, made after a Will
is sealed, &c.*

BE it known unto all men by these presents, That I, A. B. of &c. grazier, have made and declared that my last will and testament in writing, bearing date, &c. I the said A. B. do, by these presents contained in this codicil, confirm and ratify my last will, and do give and bequeath unto H. L. of &c. And my will and meaning is, that this codicil or schedule be esteemed and adjudged to be part or parcel of my said will and testament, and that all things therein contained and mentioned be faithfully performed, in as full and ample a manner, in every respect, as if the same were so declared and set down in my said will. In witness whereof, I the said A. B. have hereunto set my hand and seal the 3d day of July, 1780.

Another Will.

IN the name of God, Amen. I K. L. of &c. being through the abundant mercy and goodness of God, though weak in body, yet of a sound and perfect understanding and memory, do constitute this my last will and testament, and desire it may be received by all as such: First, I most humbly bequeath my soul to God my maker, beseeching his most gracious acceptance of it, through the all-sufficient merits and mediation of my most compassionate Redeemer Jesus Christ, who gave himself to be an atonement for my sins, and is able to save, to the uttermost, all that come unto God by him; seeing he ever liveth to make intercession for them, and who, I trust, will not reject me, a returning penitent sinner, when I come to him for mercy; in this hope and confidence I render up my soul with comfort, humbly beseeching the most blessed and glorious Trinity, one God most holy, most merciful and gracious, to prepare me

me for the time of my dissolution, and then to take me to himself into that peace and rest, and incomparable felicity, which he has prepared for all that love and fear his holy name, Amen, blessed be God. I give my body to the earth, from whence it was taken, in full assurance of its resurrection at the last day. As for my burial, I desire it may be decent, without pomp or state, at the discretion of my dear wife, and my executors hereafter named, who, I doubt not, will manage it with all possible prudence. As to my worldly estate, I will and positively order, That all my debts be paid. First, I give to my dear and loving wife, for the term of her life, this house wherein I now dwell with all the furniture, and the lands and tenements that lie about it; and after her death, to my only son M. and his heirs and assigns for ever; to whom I leave also, from the time of my death, my other two estates situate in the parish of B. he paying to each of his sisters, P. and R. 500l. And if he die before them, and without issue, then his land (all but the value of 500l. which I freely empower him to dispose of as he shall think fit) shall descend and belong equally to those my two daughters. My poor debtors, who owe me some small matters, which, because they are low in condition, and not well able to pay them, I freely remit them all, forgiving such my debts, as I desire God would forgive my debts for Christ's sake. I give 100l. to be distributed according to the discretion of my executors, among such of my neighbours of this parish, as they apprehend most to want such assistance, but who do not at present receive alms, nor have any allowance from the parish. I give 40l. towards that good work for teaching poor children to read, and to say their catechism in charity schools. The small remainder of my estate I give to my very good friends, and dear and kind relations, A. B. and C. D. to be divided equally between them: And do constitute them executors of this my last will and testament, and trustees for my wife and children. In witness whereof, I have
here-

hereunto set my hand and seal, the first day of March, in the year of our Lord, 1780.

Witnesses, B. C.

D. E.

H. I.

K. L. (L. S.) Here I take off my seal, and do declare this to be my last will and testament.

OBSERVATIONS. *Note,* That the party who signs and seals this will, is to do it in the presence of three witnesses, who are to set their hands to it; but it is not of much consequence whether the witnesses hear the will read or no, provided they hear the party say he acknowledgeth that writing to be his will, to which he sets his hand and seal; for, if they did hear it read, it cannot be supposed that they can remember the contents thereof. A man above fourteen years of age may make a will of his goods; and a woman above twelve. But neither can will their lands until twenty-one years.

If a man dies without a will, and leaves both free-lands and goods, his wife will have the third part of the profits of the land during her life, and one third part of the goods for ever; and the next a-kin to the husband the other two third parts. But he that makes a will, and leaves his wife a certain sum to be paid her yearly, during her life, by his executor, should also give her some of his moveable goods.

If a man dies without a will signed and sealed, leaving many children, the eldest son claims all the land; but, if he leaves daughters only, they will be coheirs to all free-land.

Copyhold land is not given by will, but pass'd by surrender in court.

Wills by word of mouth, called Nuncupative Wills, are not good to pass freehold land; but for goods, or leasehold land, they often pass the court for good, if under 30l. value, the court writing one from the mouths of three or four witnesses, to which they give oath, and put it in writing within six months after the party's decease.

The

The word executor is the name given to him that is to see the will performed: But, if it be a woman, she is called in the will executrix.

The Form of a letter of Attorney, to execute a particular Business.

KNOW all men by these presents, that I F. G. of H. in the county of K. grazier, for divers good causes and considerations me hereunto moving, have made, ordained, constituted and appointed, and by these presents do make, ordain, constitute, and appoint my trusty friend, M. N. of P. Gent. my true and lawful attorney, for me, in my name, and to my use, to ask, demand, recover, and receive of, and from, R. S. of &c. the sum of, &c. Giving, and by these presents granting to my said attorney, my sole and full power and authority to take, pursue, and follow such legal courses for the recovery, receiving, and obtaining of the same, as I myself might, or could do, were I personally present; and, upon the receipt of the same, acquittances, or other sufficient discharges for me, and in my name, to make, sign, seal, and deliver: As also one or more attorney or attornies under him to substitute and appoint, and again at his pleasure to revoke; and further to do, perform, and finish for me, and in my name, all and singular thing or things, which shall or may be necessary, touching and concerning the premises, as fully, thoroughly and entirely, as I the said F. G. in my own person might, or could do, in or about the same: Ratifying, allowing, and confirming whatsoever my said attorney shall lawfully do, or cause to be done, in and about the execution of the premises, by virtue of these presents. In witness whereof, I have hereunto set my hand and seal; the 2d day of July, in the 20th year of the reign of our Sovereign Lord GEORGE the 3d, by the grace of God, king of Great Britain, &c. and in the year of our Lord God, 1780.

H

The

THE YOUNG MAN'S

The Form of a Revocation of a Letter of Attorney.

KNOW all men by these presents, That whereas I R. S. of L. in the county of K. grazier, upon the trust and confidence which I had in M. N. of, &c. Gent. by letter of attorney under my hand and seal, bearing date, &c. did make, ordain, constitute and appoint the said M. N. my lawful attorney, for me, and in my name, and to my use, to ask, demand, recover, and receive, of and from A. B. of &c. falter, the sum of &c. as thereby more at large may appear: Now know ye, that I the said R. S. for divers good causes and considerations me hereunto moving, have, and by these presents do revoke, disannul, and make void the said letter of attorney, and all power and authority therein to him the said M. N. given. In witness, &c.

The Form of an Indenture for an Apprentice.

THIS Indenture witnesseth, That A. B. son of C. D. &c. doth put himself apprentice to E. F. weaver, to learn his art or mystery, and with him, after the manner of an apprentice, to serve from the day of the date hereof, for and during the term of seven years next ensuing; during all which term, the said apprentice his said master faithfully shall serve, his secrets keep, and all his lawful commands every where gladly do: He shall do no damage to his said master, nor see it to be done by others, without letting or giving notice thereof to his said master: He shall not waste his said master's goods, nor lend them unlawfully to any. He shall not commit fornication, nor contract matrimony during the said term: He shall not play at cards, dice, or any other unlawful game, whereby his said master may be damaged, with his own goods, or the goods of others: He shall not absent himself day nor night from his said master's service unlawfully; nor haunt ale-houses, taverns,

taverns, or play-houses; but in all things behave himself as a faithful apprentice, in the trade or mystery he now followeth; and the said master shall procure and provide for him sufficient meat, drink, apparel, lodging, washing, and all other necessities, during the said term. And, for the true performance of all and every the said covenants and agreements, either of the said parties bindeth himself unto the other firmly by these presents. In witness whereof, they have interchangeably set their hands and seals hereunto, this tenth day of July, in the twentieth year of the reign of our Sovereign Lord GEORGE the third, king of *Great Britain, France, and Ireland, &c.* and in the year of our Lord, 1780.

A Letter of Attorney from a Seaman.

KNOW all men by these presents, That I G. R. mariner, now belonging to his Majesty's ship the &c. for divers good causes and considerations me hereunto moving, have, and by these presents do make, ordain, constitute and appoint my trusty friend T. S. citizen and joiner of London, my true and lawful attorney for me, in my name, and for my use, to ask, demand, and receive of and from the right honourable the treasurer, or pay-master of his majesty's navy, and commissioners for prize-money, and whom else it may concern; as well all such wages, and pay, bounty-money, prize-money, and all other sum and sums of money whatsoever, as now are, and which hereafter shall or may be due or payable unto me; also all such pensions, salaries, smart-money, and all other monies and things whatsoever, which now, or at any time hereafter, are or shall be due to me for my service, or otherwise, in any of his majesty's ship or ships, frigates or vessels: Giving and hereby granting unto my said attorney full and whole power to take, pursue, and follow such legal ways and courses for the recovery, obtaining, and discharging the said sum and sums of money, or any of them,

as I myself might, or could do, were I personally present. And I do hereby ratify, allow, and confirm, all and whatsoever my said attorney shall lawfully do, or cause to be done, in and about the execution of the premises, by virtue of these presents. In Witness, &c.

A B Q N D.

K NOW all men by these presents, That I [Adam Andrews, in the county of Essex, glover] am held and firmly bound unto [John Johnson, of Brentford in the county of Middlesex, Esq.] in the sum of (two hundred) pounds of good and lawful money of Great Britain, to be paid to the said [John Johnson] his heirs, executors, administrators, or assigns: To which payment, well and truly to be made, I bind myself, my heirs, executors, administrators, and assigns, firmly by these presents. Sealed with my seal. Dated the (second day of June) in the (20th) year of the reign of our Sovereign Lord, GEORGE the third, by the grace of God king of Great Britain, France, and Ireland, defender of the faith, and in the year of our Lord God, 1780.

The CONDITION.

THE the condition of this obligation is such, that if the above-bounden [Adam Andrews] his heirs, executors, or administrators, do well and truly pay, or cause to be paid, unto the abovementioned [John Johnson] his executors, administrators, or assigns, the full sum of (one hundred pounds) with lawful interest for the same, of good and lawful money of Great Britain, on the (2d day of March) next ensuing the date hereof; then this obligation to be void, or else to remain in full force.

Seal'd and deliver'd (being
first legally stamped) in Adam Andrews, (L. S.)
the presence of R. C.
C. H. When

☞ When a bond is given in consideration of the value received, the bond is always to be made for double the value in the condition.

What is to be varied, and made agreeable to the circumstances before you, is contained in those words inserted either between [] or ()

A Condition to stand to the Award of Arbitrators.

THE condition of this obligation is such, That if the above-bounden [Adam Andrews, of Chelmsford, glover] his heirs, executors, administrators, and every of them, do and shall in all things well and truly stand to, obey, abide by, perform, fulfil, and keep the award, order, arbitrament, final end and determination of [David Davis, and Frederick Ferrers; of Chelmsford, grocers] arbitrators indifferently named, elected, and chosen, as well on the part and behalf of the above-bounden [Adam Andrews] as of the above-named [John Johnson] to arbitrate, award, order, judge, and determine of and concerning all manner of action and actions, cause and causes of actions, suits, bills, bonds, specialties, judgments, executions, extents, accounts, debts, dues, sum and sums of money, controversies, trespasses, damages, and demands whatsoever, at any time or times heretofore had, made, moved, brought, commenced, sued, prosecuted, done, suffered, committed, or depending by or between the said parties, so as the award may be made and given up in writing, under their hands and seals, ready to be deliver'd to the said parties on or before the (second of June next ensuing the date above-mentioned :) But if the said arbitrators do not make such their award, of and concerning the premises, by the time aforesaid; That then, if the said [Adam Andrews] his heirs, executors, and administrators, for his and their parts and behalf, do in all things well and truly stand to, obey, abide by, perform, fulfil, and keep the award, order, arbitrament, umpirage, final end and determination of

[Robert Reynolds, of Chelmsford, Esq.] umpire, indifferently chosen between the two parties, to end the said matter and differences, so as the said umpire do make his award or umpirage, of and concerning the premises, and deliver the same in writing under his hand and seal, to the said parties, on or before the (third day of *May*) next ensuing the date abovesaid: Then this obligation to be void, or else to remain in full force.

Seal'd and deliver'd (being legally stamp'd) in Adam Andrews, (L.S.) presence of, &c.

Note, Both the parties are in this case to be mutually bound; and, if there be no umpire admitted of, the latter part of the condition, beginning (*But if the said arbitrators*) is to be omitted.

The Form of an Umpirage of Award.

TO all people to whom this present writing shall come: I [Robert Reynolds, of Chelmsford, Esq.] umpire indifferently chosen between [Adam Andrews, of Chelmsford, glover, and John Johnson, of Brentford, Esq.] send greeting: Now know ye, that I the said [Robert Reynolds] having deliberately heard, and understood, the griefs, allegations, and proofs of both the said parties; and being willing, as much as in me lieth, to set the said parties at unity and good accord, do by these presents arbitrate, award, order, deem, decree and judge, that the said [Adam Andrews] his executors, administrators, or assigns, do, and shall well and truly pay, or cause to be paid, unto the said [John Johnson] his executors, administrators, or assigns, the full sum of (two hundred pounds) of lawful money of *Great Britain*, on the (first day of *June*) next ensuing the date of these presents; and that upon payment thereof, the said [Adam Andrews and John Johnson] shall, at their own proper costs and charges, seal, subscribe, and, as their several acts and deeds, deliver each to the other, a general release in writing, of all matters, actions, suits, causes of actions, bonds, bills, covenants, controversies, and demands whatsoever,

foever, from the beginning of the world to the (second day of *June* last past) and in the (20th) year of our Sovereign Lord, *GEORGE*, king of *Great Britain*, &c. In witness whereof I have hereunto set my hand and seal, the 4th day of *July*, 1780.

Seal'd and deliver'd (being duly stamp'd) in Robert Reynolds, (L.S.) presence of, &c.

A Letter of License to a Debtor.

TO all people to whom this present writing shall come: We whose names are hereunto subscribed, and seals affix'd, creditors of (C. D. of London, merchant,) send greeting. Whereas the said (C. D.) on the day of the date of these presents, is indebted unto us severally, in divers considerable sums of money, which at present he is not able to satisfy unto us, without respite and time to be given unto him for the payment thereof: *Know ye therefore*, That we the said creditors, for divers good causes and considerations us thereunto moving, have given and granted, and by these presents do give and do grant unto the said (C. D.) our sure and safe conduct, and free license, that he the said (C. D.) shall and may safely come and go, and resort unto us, and every one of us his said creditors, to compound and take order with us, and every one of us, for all and every of our said debts, and to go about any other business to any other person or persons whatsoever, without any trouble, suit, arrest, attachment, or other molestation to be offer'd or done unto him the said (C. D.) his wares, goods, monies, or other merchandizes whatsoever, by us, or any of us, or by the heirs, executors, administrators, partners or assigns of us, or any of us, or by our, or by any of our means and procurement, to be sought or procured to be done, from the day of the date hereof, unto the full end and term of (*one whole year*) next ensuing. And we the said creditors, whose names are here underwritten

derwritten, do hereby covenant and grant, and every one of us for his own part, his executors and administrators, covenanteth and granteth, to and with the said (C. D.) that if any trouble, wrong, damage or injury shall be done unto him the said (C. D.) either in his body, goods, or chattels, or any of them, within the said term of *(one year)* next coming after the date hereof, by us, or any of us, his said creditors, or by any other person or persons, by or thro' the procurement, consent, or knowledge of us, or any of us, contrary to the true intent and meaning of this our present writing of safe conduct, that then the said (C. D.) by virtue of these presents, shall be discharged and acquitted for ever, towards and against him and them, of us, him and his heirs, executors, administrators, partners or assigns, and every one of them, by whom, and by whose means he shall be arrested, troubled, and attacked, or damnified, of all manner of actions, suits, quarrels, debts, and demands, either in law or equity, from the beginning of the world, to the day of the date hereof: In witness whereof, we have hereunto set our hands and seals, the first day of *March*, 1780.

Seal'd and deliver'd (being first duly stamped)
in presence of, &c.

F. G. (L.S.)
H. I. (L.S.)
K. L. (L.S.)

A Bill of Sale.

K NOW all persons whom it may concern, That I [James Jolliffe, of Liverpool, in the county of Lancaster, hosier,] for and in consideration of the sum of (fifty pounds) of lawful money of Great Britain, to me in hand paid, by [William Walters, of London, Esq.] the receipt whereof I do hereby acknowledge, have bargain'd, sold, and delivered, and by these presents according to the due form of law, do bargain, sell, and deliver unto the said [William Walters] two hundred pair mens hose, one hundred pair womens ditto, fifty boys ditto; to have
and

and to hold the said bargain'd premises unto the said [William Walters] his executors, administrators and assigns, for ever. And I the said [James Jolliffe] for myself, my executors and administrators, the said bargain'd premises unto the said [William Walters] his executors, administrators and assigns, against all persons, shall and will warrant, and for ever defend, by these presents; * Provided nevertheless, that if I the said [James Jolliffe] my executors, administrators, or assigns, or any of us, do and shall well and truly pay, or cause to be paid unto the said [William Walters] his executors, administrators, or assigns, the sum of (fifty-one pounds ten shillings, as principal and interest, lawful money of Great Britain, on the tenth of August next ensuing the date hereof) for redemption of the bargained premises, then this present bill of sale shall be void and of none effect: But if default be made in the payment of the said (fifty-one pounds ten shillings) in part, or in the whole, contrary to the manner and form aforesaid, that then it shall remain and be in full force and virtue. In witness whereof, I have hereunto set my hand and seal, the first day of March, in the year of our Lord, 1780.

Sealed and deliver'd, &c. James Jolliffe, (L.S.)

A general Release

KNOW all men by these presents, That I [Peter Parker, of London, brazier,] have remitted, released, and for ever quitted claim unto [Francis Free, citizen and baker of London,] his heirs, executors, and administrators, all and all manner of actions, cause and causes of actions, suits, bills, bonds, writings obligatory, debts, dues, duties, accounts, sum and sums of money, judgments, executions, extents, quarrels, controversies, trespasses,

* If the bargained premises be redeemable, by a limited time; a proviso of this nature is added.

damages

damages and demands whatsoever, both in law and equity, or otherwise howsoever, which against the said [Francis Free] I ever had, now have, and which I, my heirs, executors, and administrators, shall or may have, claim, challenge or demand, for or by reason or means of any matter, cause or thing, from the beginning of the world to the day of the date of these presents. In witness whereof, I have hereunto set my hand and seal, the third day of July, in the year of our Lord, 1780.

Sign'd, seal'd, and deliver'd,

(being first legally stamp'd)

&c.

Peter Parker, (L.S.)

Forms of Receipts, Notes, Bills of Parcels, &c.

Various Forms of Acquittances, when an Apprentice or Servant receives Money for the Use of his Master or Employer.

RECEIVED, the 10th of August, 1780, of Mr. Peter Paterfon, ten pounds, ten shillings, for my master, Henry Horn, on account,

£. 10 10

Per William Wade.

Received, the 1st of May, 1780, of Oliver Onslow, seventy-five pounds, fifteen shillings, and six pence, in full payment for my Uncle John Jennings,

£. 75 15 6

Per David Dawson.

Received, the 4th of June, 1780, of Francis Freeman, three hundred and ten pounds, for my father, George Johnson,

£. 310

Per John Johnson.

Received

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Received, the 18th of June, 1780, of the worshipful company of Stationers, eighty-seven pounds, for my brother, George Gregory,

£. 87

Per Gabriel Gregory.

Received, the 27th of April, 1780, of Mr. Henry Hinton, twenty-five pounds, for half a year's rent, due last Lady-day, for my master, Robert Ray,

£. 25

Per Samuel Simpson.

Received, the 9th of September, 1780, of Mr. Humphry Higgins, by order and on account of Mr. James Jeffreys, two hundred and fifty pounds, ten shillings, and sixpence, for Mr. William Wilson, and company,

£. 250 10 6

Per Adam Ashley.

Received, the 10th of October, 1780, of Mr. Peter Prescot, forty-three pounds, eight shillings, and sixpence, in part of a bill of one hundred pounds, payable to Mr. Ralph Rawlinson, due the 1st instant,

£. 43 8 6

Per Richard Rogers.

*Various Forms of Acquittances, upon Receipt of Money,
by Masters and Men of Business themselves.*

RECEIVED this 4th of May, 1780, of Mr. John Jardine, two hundred and ten pounds on account,

£. 210

Per Thomas Tate.

Received

Received the 5th of June, 1780, of William Webb, Esq. the sum of four hundred and thirty pounds, in full of all demands, for self and company,

£. 430

Per Thomas Tonson.

Received the 10th of March, 1780, of Mr. David Dawson, the sum of five pounds, five shillings, in part of my salary,

£. 5 5

Per Edward Evans.

Received the 8th of April, 1780, of Mr. Samuel Sims, fifty pounds, in full for the difference of four thousand pounds bank stock,

£. 50

Per Henry Hughes.

Received the 4th of July, 1780, of Mr. Jacob Jones, twenty pounds, in full for one year's interest of four hundred pounds, due at Midsummer last,

£. 20

Per George Green.

Received the 12th of January, 1780, by the order and for the use of Mr. Peter Page, of Mr. James Jay, ten pounds, and allowed for taxes and repairs three pounds, in full for half a year's rent due at Christmas,

£. 13

Per Peter Pugh.

Received the 19th of July, 1780, of Mr. Isaac Innis, fifty pounds, in full for a year's rent, due at Midsummer last, out of which, deducted for taxes, ten pounds; and for repairs four pounds; I say received for and by order of Ralph Read, Esq.

£. 50

Per Matthew Moore.

Received the 17th of January, 1780, by the hands of Mr. Peter Paul, by order of Luke Law, Esq. twenty pounds ten shillings, allow'd for taxes three pounds

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pounds ten shillings, in all twenty-four pounds, being for half a year's rent due at Christmas last, from Mr. Adam Aftley,

£. 24

Per Henry Hall.

Received the 10th of July, 1780, of the executors of Henry, late Lord Holland, by the hands of Mr. John Brett, the sum of sixty pounds, in full for my half year's annuity due at Midsummer last,

£. 60

Per George Jones.

Promissory Notes by Bankers Apprentices and Servants.

London, May 17th, 1780.

I PROMISE to pay Thomas Trott, Esq. or bearer, on demand, eighty pounds,
For Mr. Henry Hoare and partners,

£. 80

Per William Wynne.

London, March 15th, 1780.

I promise to pay to the governor and company of the bank of England, or bearer, on demand, six hundred pounds,

For my uncle John Jebb,

£. 600

Per James Jebb.

London, November 9th, 1780.

I promise to pay to the royal African company, or bearer, on demand, five hundred and fifty pounds, ten shillings, and sixpence, for my Master, Peter Pitt,

£. 550 10 6

Per Hugh Hill.

Promissory Notes for a Man's Self, &c.

I PROMISE to pay to Mr. Robert Rich, or bearer, on demand, nine hundred pounds, March 18, 1780.

£. 900

Per Paul Percy.

I promise to pay to the royal African company on demand, three thousand pounds, June 6th, 1780, for self and partners,

£. 3000

Per George Gay.

London, June 3d, 1780.

I promise to pay Mr. David Day, cashier of his Majesty's revenue of excise, or order, sixty days after date, two hundred and ten pounds, value received,

£. 210

Per Peter Price.

I promise to pay to Ralph Ray, Esq. or order, on demand, five hundred and ten pounds, ten shillings, and sixpence, value received this 19th of June, 1780.

£. 510 10 6

Per Francis Free.

I promise to pay to Sir Simon Sim, or order, the sum of ninety pounds in manner following; thirty pounds, part thereof, two months after date, thirty pounds more the 10th of May next, and the remaining thirty pounds the 29th of July, 1781, value received: Witness my hand at *London*, the 28th of June, 1780,

£. 90

Per Peter Pratt.

London, July 8th, 1780.

I promise to furnish Mr. Henry Hill, on demand, with bills of exchange to the value of ten thousand pounds *Sterling*, at the price current, payable to himself,

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self, or order, in Antwerp, the next ensuing fair, value of Sir Charles Afgill received,

£. 10,000

Per Robert Renny.

I promise to pay to Peter Perry, Esq. or order, the sum of sixty pounds on demand, after the receipt of a bill of exchange drawn the 10th current, by Paul Price, on John James, of Bristol, grocer, for the like sum, payable to William Wise, Esq. or order, which the said Peter Perry, has indorsed to me this 10th of June, 1780.

£. 60

Per Adam Anson.

A Promissory Note, mentioning order, is indorsable from one person to another, which is done by the present possessor's writing his name on the back of it, and delivering it up to the party, to whom he intends to assign over his property therein.

It is unnecessary to have a promissory note, payable to bearer, indorsed, if you are satisfied the note is good.

The delivering up a promissory note to the person who signed it is a sufficient voucher of its being paid; nor is there any need of writing a receipt thereon.

Promissory notes, and book debts, if not legally demanded in the space of six years, cannot be recovered by law, upon the debtor's pleading the statute.

If you keep a promissory note upon demand in your own hands above three days, and the person it is upon should fail, the loss will be your own; but if he fail within three days, it will light in equity on the person that paid it you.

N. B. Observe in Promissory Notes, that the value received is mentioned: or they are of no force.

BILLS OF PARCELS.

A Linen-Draper's Bill.

Mrs. Anne Adams,

1780,

Bought of James Jay and partners.

	s.	d.	l.	s.	d.
June 3,					
20 Ells of Holland at	5	6	per ell	5	10 0
10 Ells of dowlas at	1	6		0	15 0
1 Piece of cambrick				4	10 6
A piece of muslin				3	5 6
50 Ells of diaper at	1	6		3	15
				17	16 0

An Hosiery's Bill.

Mrs. Jane Page,

1780.

Bought of John James.

	s.	d.	
May 12,			
25 Pair of womens worsted mixt at	4	6	per pair.
13 Ditto of mens filk	14	4	
12 Ditto of mens yarn	2	6	
28 Ditto of Norwich hose	3	4	
18 Ditto of thread	3	6	
33 Ditto of womens gloves filk at	5	6	

A Milliner's Bill.

Mrs. More,

1780,

Bought of Anne Anson.

	s.	d.	l.	s.	d.
June 22,					
12 Yds. of flower'd ribband at	2	6		1	10 0
5 Pair of Roman gloves at	8	6	per pair	2	2 6
4 Dozen Irish lamb do. at	1	7		3	16 0
9 Sarfenet hoods, white at	5	0		2	5 0
10 Fans, French mount at	3	9		1	17 6
A piece of Mechlin lace } 19 yards at			11 10 per yd.	11	4 10

22 15 10
A China

A China Man's Bill.

The right honourable Lady Monson,
 1780, Bought of Luke Lacy.
 March 9, l. s. d.
 16 China plates — at 0 4 6 each
 10 Dishes ditto — at 0 8 4
 3 Pair of jars and a pair }
 of beakers allow'd at } — 15 8 10
 A tea table set compleat, at — 4 10 6
 Indian sprig'd muslin, 1 ps. }
 qt. 10 yards, at } 0 9
 Fine chints 10 pieces — at 4 4 per piece

A Fruiterer's Bill.

Mrs Sarah Sim,
 1780, June 10, Bought of Peter Plumbe,
 3 Dozen of Malaga lemons at 2 6 per dozen
 4 Hundred of Lisbon ditto at 8 4 per hundred
 19 Ropes of Spanish onions at 1 10 per rope
 2 Bushels of do. chefnuts at — 13 6
 50 Dozen of best China and }
 Sevil oranges at — } 1 6 per dozen
 20 Pomgranates — 5 each

A Fishmonger's Bill.

Mr. Henry Hall,
 1780, Bought of Simon Scot,
 May 18, l. s. d.
 4 Hundred of haberdine at 6 8 4 per C.
 2 Hundred of Ling — at — 18 10 4
 3 Hundred of Stockfish at 3 10 6 per C.
 2 Caggs of Sturgeon — at 0 8 4 per Cagg
 10 Barrels of herrings — at 2 17 6 per barrel
 74 Dried salmon — at 0 6 4 each

I 3

A Teaman's

A Teaman's Bill.

John Jebb, Esq.

Bought of Robert Ray, March 2, 1780.

lb.		s.	d.
20	Of Smyrna Coffee --	at 6	6 per lb.
43	Of Mocha ditto --	at 5	10
19	Of Imperial tea --	at 25	0
12	Of the best bohea --	at 12	6
14	Of royal green tea --	at 17	6
30	Of sugar double refined at	1	2

A Salter's Bill.

Mrs. Andrews,

1780,

Bought of John Jacob, and partner,

June 10,

		s.	d.
15	Pounds of anchovies --	at 1	5 per pound
40	Do. of capers --	at 0	11
10	Do. of salt-petre --	at 1	4
3	Gallons of pickled } Mushrooms --	at 3	9 per quart
6	Gallons of Lucca oil at	13	0 per gallon
A	Westphalia ham, wt. 24 lb. at	1	0 per pound

A Pewterer's and Brazier's Bill.

Mr. Evan Ellis,

1780,

Bought of Peter Pitt,

July 16,

		l.	s.	d.
Hard metal plates 4 doz. wt. 50 lb.	at 0	1	5	pr pound
8 Dishes do. a monteth, and } cullender, wt. 44 lb.	at 0	1	7	ditto
A copper with a discharging } cock, wt. 70 lb. --	at 0	1	6	ditto
Iron work to do. and a crane, } wt. 9 lb. --	at 0	0	3	ditto

A stove,

UNIVERSAL COMPANION. 91

A stove-grate, with shovel, tongs, poker, and fender	}	at 0 1 9
A large brass pot and saucepan wt. 38 lb.		

A Furrier's Bill.

Mr. Benjamin Brown,	Bought of Mark Massey,		
1780.	s. d.		
March 2,			
Coney skins 1100	at 14	4 per hundred	
Beaver do. 170 lb.	at 6	9 per pound	
A sable muff and tippet		allow'd at 19s.	
Fitch skins 80	at 0	4 per skin	
Otter skins 70	at 4	0	
Hare skins 147	at 8	8 per hundred	

A Leatherfeller's Bill.

Mr. Nathan Norton,	Bought of William Wilson,		
1780,	s. d.		
June 20,			
Large oil'd lamb skins 310	at 1	4 per skin	
Goat skins 140	at 0	10 ditto	
Allum'd sheep skins 158	at 1	5 ditto	
Calves skins 16	at 4	6 ditto	
Oil'd buck 17	at 11	4 ditto	
Russia hides 80	at 13	3 ditto	

A Cheesemonger's Bill.

Mr. Adam Andrews,	Bought of James Jones,		
1780,	C. q. lb. l. s. d.		
November 10,			
14 Old Cheshire cheeses 6	1 10	at 1 18 6 per C.	
47 Gloucestershire ditto 5	1 8	at 1 13 0	
4 Tedder ditto 3	1 21	at 2 14 6	
9 Flitches of bacon, wt. 57 stone	at 0 3 6	pr stone	

14 Fir-

THE YOUNG MAN'S

14 Firkins of butter ——— at 1 12 0 each
 Suffolk butter ——— 13 weys at 8 1 6 per wey

A Grocer's Bill.

Mr. Thomas Tonson,

1780,

Bought of John Johnson and Co.

March 14,

C. q. lb. - l. s. d.

Sugar 3 hhds. nt. 23 3 16 at 1 4 6 per C.

Raisins 4 barrels 16 1 10 at 1 15 7 ———

Rice 2 barrels — 2 2 6 at 4 18 8 ———

Pepper 2 bags — 2 1 10 at 2 18 10 ———

Brimstone — 1 2 20 at 2 3 0 ———

Bees wax 4 cakes — 3 1 7 at 1 17 6 ———

A Mercer's Bill.

Mrs. Catharine Collet,

Bought of Patrick Pugh and Simon Sims,

June 10, 1780,

s. d.

14 Yards of rich brocaded sattin at 12 6 pr yard

8 Do. of mohair ——— at 5 4 ———

28 Do. of Paduasoy ——— at 10 6 ———

17 Do. of flower'd damask — at 8 10 ———

44 Do. of poplin ——— at 2 8 ———

14 Do. of Italian Mantua — at 7 6 ———

17 Do. of double Taffety — at 3 1 ———

When the money is paid down, either of the
 partners may write,

*Received the contents in full of all demands, for self
 and partner,*

per Simon Sims.

A Wool-

A Woollen Draper's Bill.

Mr. Henry Hartley,

Bought of David Davis and Co.

		s.	d.
Jan. 10, 1780,			
12 Yards of Yorkshire cloth —	at 7	6	per yard
9 Do. of fine Spanish black	at 17	6	—
8 Do. of fine grey cloth —	at 16	8	—
20 Do. of frieze —	at 4	6	—
6 Do. of fine drab —	at 14	4	—
57 Do. of superfine Spanish cloth	at 17	0	—
24 Do. of livery scarlet cloth	at 12	6	—

Receiv'd the full contents, for David Davis and
Company, per Daniel Drake,

BILLS on BOOK-DEBTS.

An Upholsterer's Bill.

The right honourable the Earl of Egmont,

1780,

Bought of Francis Freeman,

		l.	s.	d.
March 10,	A rich crimson damask bed laced compleat	80	0	0
May 11,	A set of window curtains and vallance ditto —	20	10	6
June 4,	A fine carpet, counterpane and an otter down quilt	14	10	6
July 9,	A crimson velvet easy cheir, and 4 stools ditto —	19	8	6
— 17,	A wrought bed dimity, and furniture compleat. —	30	10	6
Aug. 12,	A down bed, bolster, pillows, with a mattrafs and quilt	16	0	0
— 14,	Chairs 12 with two arm'd do. walnut-tree fram'd	36	10	6
Sum		£. 217	10	6

18

If a servant receives the bill, let the receipt run thus,
*Received the 10th of December, 1780, of the Right
 Hon. the Earl of Egmont; by the hands of Mr. Simon
 Steward, the full contents, for my master Francis Free-
 man,*
Per C. Child.

A Goldsmith's Bill.

1780,		The honourable Sir George Savile, Bart. Bought of William West,			
		oz.	dwt.	gr.	s. d.
March 10,	For a silver set of castors	27	8	9	at 6 10
May 9,	Half a dozen of } soup plates	76	10	14	at 6 8
— 12,	A silver tea-pot } and lamp	28	14	11	at 6 9
June 12,	A large punch } bowl —	71	5	11	at 7 2
July 7	A doz. of silver } spoons —	34	6	8	at 6 10

A Cabinet-Maker's Bill.

1780,		The right honourable the Earl of Essex, Bought of William White,		
		l.	s.	d.
April 10,	A chimney glass and a pair of sconces	6	12	6
May 4,	A pair of pier glasses 80 inches by } 20, in gilt frames	40	0	0
June 9,	A pair of India cabinets 48/ } each	96	0	0
— 24,	A fine Indian four-leav'd screen, } and fire screen	20	10	6
July 15,	A book-case with glass doors, } and a corner cupboard, do.	24	0	0
— 28,	A walnut-tree table and a set of } dressing boxes japan'd	4	6	6

August

UNIVERSAL COMPANION. 95

Aug. 9,	A tea table and stand plated, wt. } 60 0 0
	120 oz. at 10s. per ounce
—23,	Two dozen of fine matted chairs } 9 12 0
	at 8s. each
£. 241 1 6	

Received the 16th of September, 1780, of the Right Hon. the Earl of Essex, the contents in full of this bill for Mr. William White,

Per Robert Ray.

A Factor's Bill.

Messrs. Stone and Strutt, Bought of John Jacob,		1780, and company,		
May 8,		s. d.	l. s. d.	
For Serge de Nîmes 15 }	at	4 0	per yard	120 0 0
ps. each 40 yards }				
June 9, Silk drugget 20 }	at	6 0	ditto	180 0 0
each 30 yards }				
July 1, Grograms 10 }	at	3 0	ditto	60 0 0
each 40 yds. }				
17, Silk camblets 20 }	at	4 0	ditto	120 0 0
each 30 yds. }				
Aug. 8 Duroys 50 —	at	30 0	per piece	75 0 0
Dec. 9, Sagathies 25 each }	at	1 6	per yard	37 10 0
20 yards }				
£. 592 10 0				

A Lighterman's Bill.

Mr. George Green, Dr.		To John Jay,	
1780,		l. s. d.	l. s. d.
July 16,			
Coals in the pool 50 chaldrons	at 1 5	opr ch.	62 10 0
Metage of 50 chaldrons	— at 0 0 8	—	1 13 4
Lighterage of ditto	— at 0 0 10	—	2 1 8
Wharfage			

Wharfage of ditto — at 0 0 2 — 0 8 4
 Cartage of said 50 chaldrons at 0 2 6 — 6 5 0

£. 72 18 4

N. B. One and twenty chaldrons are the score of sea-coal.

A Wine Merchant's Bill.

Mr. Samuel Scott,

Bought of Mark May,

1780.	s.	d.
May 20, Palm sack 20 gallons, at 10 0 per gall.	10	0
June 18, Port red 40 ditto — at 6 0 —	6	0
July 29, Sherry 28 ditto — at 7 0 —	7	0
— 31, Rhenish 16 ditto — at 7 2 —	7	2
Aug 10, White Lisbon 40 do. at 4 8 —	4	8
— 17, A chest of Florence agreed for — 3 18	3	18

A Bricklayer's Bill.

Sir Charles Crofts, Dr.

To George Gray, for work and materials in his house on Cornhill, London.

1780,	s.	d.	l.	s.	d.
May 16, Bricks 30 thousand at 16 0 pr M.	16	0	24	0	0
— 28, Tiles 10 ditto — at 18 0 —	18	0	9	0	0
June 4, Lime 30 hundred at 14 0 pr H.	14	0	21	0	0
— 10, Sand 16 load — at 3 6 pr L.	3	6	2	16	0
July 17, Ridge tiles 200 — at 8 0 pr H.	8	0	0	16	0
Sept. 19, Work for myself } at 3 0 pr D.	3	0	9	0	0
60 days — }					
— Do. for a labourer 60 at 1 6 —	1	6	4	10	0
— Do. for my man 60 at 2 6 —	2	6	7	10	0

£. 78 12 0

Note, A brick ought to be 9 inches long, $4\frac{1}{2}$ broad, and $2\frac{1}{2}$ thick: 500 bricks are a load, 1000 tiles the like,

UNIVERSAL COMPANION. 97

like, 25 bushels are a hundred of lime; about 3000 bricks will make a rod of brick-work, viz. 272½ square feet, a brick and a half thick.

A N O T H E R.

His Grace the Duke of Northumberland, Dr.

For bricklayers work at Sion-House, perform'd by Samuel Stone.

		<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
Brick-work 60 rods statute measure	} at 6 0 0 pr rod	360	0	0			
Tiling plain 48 square	at 2 6 0 pr squ.	41	8	0			
Rubb'd return 270 feet	at 0 3 0 pr foot	40	10	0			
Straight arch 80	at 0 2 0	8	0	0			
Jack arch 40	at 0 2 0	4	0	0			
Paving with 10 inch tiles 1000 feet	} at 0 0 4	16	13	4			
Measured July 22, 1764,							
					£. 470	11	4

A Builder's Bill.

His Grace the Duke of Marlborough, Dr.

To Peter Pine, for work and materials in Blenheim-House,

		<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
1780, May 19, Oaken timber 16 load	} at 3 0 0 a load	48	0	0			
—24, Fir timber 40 ton	} at 0 10 6 a load	21	0	0			
June 9, Oaken plank 80 feet	} at 0 0 4 pr foot	1	6	8			
—19, Norway deals 600	at 6 0 0 pr H.	36	0	0			
—Sixpenny nails 30 thousand	} at 0 4 0 pr M.	6	0	0			
July 4, Ten groat nails 2000	} at 0 14 0 ditto	1	8	0			

K

Augt

Aug. 20, Work for my- self 80 days	} at	0	3	6	pr day	14	0	0
Do. for 4 men 80	at	0	2	6	each	40	0	0
Wainscot 70 yards	at	0	3	0	pr yd.	10	10	0
Double quarter 60 feet	} at	0	0	4	pr foot	1	0	0

£. 232 14 8

Note, Deals and nails are 120 to the hundred; 50 feet are a load, and 40 feet a ton of timber.

A Corn Chandler's Bill.

George Gay, Esq.

Bought of Peter Pott and partners,

1780,			s.	d.
May 19,	Oats	— 6 qrs.—at	2	6 per bushel
June 10,	Beans	— 7 bush. at	4	6
July 12,	Bran	— 9 qrs. at	1	9
Aug. 17,	Tares	— 14 bush. at	1	10
— 26,	Pease	— 18 ditto at	3	9½
Sept. 12,	Pale malt	40 ditto at	3	4

A Dyer's Bill.

Mr. David Day,

Bought of James Jebb, packer,

1780,			Ps.	s.	d.
March 2,	Exeter stuffs, yellow	44 at	15	0	pr piece
April 10,	Norwich do. blue	50 at	12	6	
May 29,	Tammies black	— 67 at	13	6	
June 10,	Colchester bays green	48 at	8	8	
July 24,	Camblets orange	— 30 at	14	0	

An

An Upholsterer's Bill.

Mr. Robert Ruffel,

Bought of Charles Crofts and company,

1780,			l.	s.	d.
May 9,	Superfine blankets	15 pr. at	1	5	6 pr pair
— 16,	Medium ditto	— 14 — at	0	14	10 ditto
—	Harrateen blue	— 40 ps. at	0	2	6 pr p.
June 10,	Cheney ditto	— 10 — at	1	16	4 ditto
— 24,	Green linseys	— 15 — at	1	4	6 ditto
July 19,	12 printed callico quilts	at	0	18	0 each

A Silkman's Bill.

Mrs. Helen Henry,

Bought of William West and partners

1780,			lb.	s.	d.
March 18,	For Tripoli belladine filk	50 at	17	10	per lb.
April 19,	Legee of Smyrna	24 at	15	6	ditto
— 24,	A fangot of raw filk	110 at	14	0	ditto
June 10,	Do. of Ardas	— 120 at	11	8	ditto
— 19,	Gold & silver twist	16 at	7	0	per Oz.
—	Twisted filk in grain	14 at	3	6	ditto

An Ironmonger's Bill.

Mr. Robert Ralph,

Bought of Samuel Smith.

1780,				s.	d.
May 12,	For Spring door locks with hinges	20 at	4	6	each
July 19,	Bolts 54 pounds	— at	0	10	per lb.
Aug. 11,	Birmingham brass locks	20 at	8	0	each
— 19,	A cast iron back wt.	12 16 at	15	6	per H.
Sept. 11,	Sheffield nails wt.	13 10 at	0	5	per lb.
— 17,	Plate iron wt.	— 4 1 8 at	0	7	ditto

THE YOUNG MAN'S

A Druggist's Bill.

Mr. Jacob Jones,

1780.

Bought of Thomas Thrale,

June 16,

C.

1b.

1.

5.

d.

For galls wt. 2 Gr. 17 Tr. lb at 0 0 10 per lb.

July 29, Mestica cochineal 24 at 1 14 6 do.

Aug. 17, Scammony ——— 14 at 0 9 0 do.

—22, Gum Arabic — 1 No at o o 9 do.

Sept. 3, Saffafrass — 4 hundred at o o 4 do.

—28, Opium — 12 pounds at 0 0 7 do.

A Tobacconist's Bill.

Mr. George Grey,

Bought of William Wren,

1780.

5.

d.

March 24, For 2 hhds. of best }
bright tobacco qt. nt H C. } at 0 9 per lb.

bright tobacco qt. nt II C.

June 12, 1 box of Oronooko } at 1 0 —————
qt. nt. 80 lb. ————

qt. nt. 80 lb.

—20, 4 bags of old Spanish } at 0 5 —
qt. nt. 510 lb. —

qt. nt. 510 lb.

July 28, 1 hhd.—qt. gr. 608 } at o 6—
tr. 84 is nt. 524 lb. — }

tr. 84 is nt. 524 lb.

—30, 2 rolls qt. nt. 76 at 1 4—

BILLS of PARCELS, used by Merchants, and Wholesale Dealers.

Mr. Francis Free,

London, June 9, 1780.

Bought of Nathan Norton, 6 bales of French cloth,
to pay at 9 months, as follows, viz.

to pay at 9 months, as follows, viz.

No.	1	qt.	2	ps.	dowlas	at	l.	s.	d.	per	ps.	l.	s.	d.
	2		5	ps.	ditto	at	5	0	0	ditto		25	0	0
	3		6	ps.	ditto	at	3	10	0	ditto		21	0	0

No. 4

2 5 ps. ditto at 5 0 0 ditto 25 0 0

3 6 ps. ditto at 3 10 0 ditto 21 0 0

No. 4

UNIVERSAL COMPANION. 101

No. 4	3 ps. lockrams	at 3	12 0	ditto	10	16 0
5	4 ps. ditto	at 2	10 0	ditto	10	0 0
6	7 ps. ditto	at 1	18 0	ditto	13	6 0
27 ps. in all amounting to						— £. 89 2 0

Peter Pott, Esq. November 19, 1780.
Bought of Henry Holmes and Partner, 8 bags of
Farnham hops for ready money.

	C.	q.	lb.
No. 1	2	3	12
2	3	1	10
3	2	3	10
4	3	2	6
5	2	3	4
6	3	2	10
7	2	3	20
8	3	1	8

C. 25 0 24 at 15. per pound £. 141 4 0

Mr. William Wynne, London, June 9, 1780.
Bought of Peter Pratt, 6 casks of Barbadoes sugar,
at 3 months, viz.

	C.	q.	lb.
1 — wt. —	6	1	24
2 —	7	2	18
3 —	8	3	10
4 —	7	2	14
5 —	6	1	26
6 —	7	2	12

q. lb.
Tare 2 10 each
6 multiply

C. 3 2 4

Gross 44 2 20
Tare 3 2 4

L. s. d.
Nett 41 0 16 at 2 16 0 per C. 115 4 0

The Form of a Bill of Lading.

SHIPPED by the Grace of God, in good order and well-conditioned, by Thomas Traffic, of London, merchant, in and upon the good ship called the (Hopewell of London) whereof is master under God for this present voyage (Samuel Seaman, of London, mariner) and now riding at anchor in (the port of London) and by God's grace bound for (Cadiz) that is to say 1 (bale of CD broadcloth, and 1 trunk, containing five hundred No. pair of silk stockings, contents, &c. as per in- 1,2 voice) being marked and numbered as per margin, and are to be delivered in the like good order at the said port of (Cadiz) the danger of the seas only excepted, unto (Mr. Peter Purchas, merchant there) or to his assigns, he or they paying freight for the said goods (three pieces of eight per C. Wt.) with primage and average accustomed. In witness whereof, the said master or purser of the said ship hath affirmed to (three) bills of lading, all of this tenor and date, one of which (three) bills being accomplished, the other (two) to stand void. And so God send the good ship to her desired port in safety. *Amen.*

Dated in London, the 1st of June, 1780, insides and contents unknown to

Samuel Seaman.

Note, The several words included in the parenthesis, are to be put into the several vacant places that are in a blank bill of lading.

Note also, Average is the general allowance made to the master of the ship, of 1d. or 2d. in every shilling freight; primage, a small allowance to be distributed among the sailors.

The

UNIVERSAL COMPANION. 103

The Form of an Invoice.

Port-Royal in Jamaica, May 6, Anno 1780.

INVOICE of five Barrels of Indigo, five Hhds of Sugar, and five Hhds of Pimento, shipped on board the Adventure of London, Robert Rudder commander, for account and risque of Timothy Tradewell, of London, merchant, being mark'd and number'd, as per Margin; contents, costs and charges, as in the following Example.

viz. Indigo 5 B.

I F

No	143
121	143
to	146
125	152
	172

756 lb. Nett, at 2s. 2d. per lb.—

l.	s.	d.
81	18	—

Sugar 5

Hhds.

Tare

C.qr.lb. C.qr.lb.

C.qr.lb.

126 11-3-27—1-2-19

Gross 68-0-00

to 12-2-19—1-3-00

Tare 8-3-12

130 13-2-13—1-2-16

14-1-15—1-3-11

Nett 59-0-16

15-1-10—1-3-22

at 24s. p. C.

70 19 5

68-0-00—8-3-12

Pimento

lb.

5 Hhds Tare

1926 Gross

N

lb. lb.

389 Tare

131 332—84

to 396—72

Nett 1537 at 11d. $\frac{1}{2}$ p. lb.

73 12 11 $\frac{1}{2}$

135 410—81

376—70

Charges

412—82

To Cost of 5 Barrels and

10 Hhds.

4-7-9

1926—389

To Storage

1-0-0

5 7 9

To Commission at 5 p. C.

Errors excepted per A. B.

23 11 10 $\frac{3}{4}$

Bufi-

Business at the Waterside, concerning exporting and importing of Goods, &c. Entering them at the Custom-house, &c.

WHEN there are goods to export and ready packed, &c. there must be first made a bill of entry, (as it is called) of the contents, after this form, viz.

*In the Happy Return, Stanley Stern; for St. Kitt's.
Thomas Traffic.*

Four bales of Linen.

Six chests of Hardware.

Of these bills there must be seven, one of which must be in words at length, and the other may be expressed in figures: These are by the clerks of the custom-house entered into several books for that purpose. If some goods pay custom, and others not, then there must be made two entries; one of those that pay custom, and another for those that pay not; and likewise you must have two cockets.

A cocket testifies the payment of all duties; and is writ on a small piece of parchment in the following words:

Know ye, that Thomas Traffic, merchant, for four bales of Linen, and six chests of Hardware, in the Happy Return, Stanley Stern, for St. Kitt's, that he hath paid the duties. Dated May 4th, 1780.

On the backside of the Cocket you must set down the marks, numbers, and quantity of the goods expressed in the inside. When on clean paper you transcribe your bill of entry, upon which a shipping bill will be made out, on the back of this signify the marks, numbers, and contents, as before on the cocket; both which being thus endorsed, you are to deliver them to the searcher at the water-side, who deposits them in the office till the going away of the ship, and then they are delivered to the captain or master of the ship.

If

UNIVERSAL COMPANION. 105

If you have not judgment or experience enough to enter your goods yourself, it is but applying to any one of the clerks of the long-room, who make it their business (and good business too) to enter people's goods; and for a shilling (you giving them the contents) they will write your bills and pass your entries, without giving you any farther trouble, or your running the risk of making any false entries, &c.

Entry Inwards.

THE ship being arrived, search the entry-book in the long-room, and you will find the name of the ship and captain, as also the waiters that are to attend the delivery of the ship, and at what key the goods will be landed. The entry inwards runs thus:

In the Speedwell, Matthew Manship, from Barbadoes.

45 Hhds. of sugar, &c.

64 Puncheons of Rum.

There must be eight of these bills, (though but seven outwards) and one of these must be in words at length (as well as one of the seven bills outwards) which is for the warrant of delivery, and must be signed by the person in whose name the goods were entered, and the mark also in the margin; which being done, and the fee for entry, and custom paid, you will then have from the land-waiters a warrant for the landing and receiving your goods.

When goods are to be exported by certificate, viz. foreign goods formerly imported; these goods being to be sent abroad, or exported to another place or country, by a native of England, within twelve, or a stranger within nine months after importation, entitle the exporter to a drawback of part of the custom paid at the importation of the said goods (producing a certificate from the Comptroller that they have paid the duties inwards) And the debenture of custom drawback runs thus:

Debenture

Deventure.

Timothy Tradewell, natual born, did, &c. make an entry with us of four thousand ells of broad German linen, in the *Dolphin*, Captain Henry Hoare, for Barbadoes, the subsidy, &c. was paid inwards by, &c. as appears per certificate of the collector inwards: And for farther manifestation of his just dealing therein, he hath also taken oath before us of the same.

Custom-House, London, 4th June, 1780.

The Oath.

Jurat. T. T. That four thousand ells of broad German linen, abovementioned, was really shipped out, and hath not been relanded in any port or creek in *England* or *Wales*, since last shipped, May 26, 1780.

The Certificate Cocket.

London: Know ye that T. T. for four thousand ells of broad German linen, paid per, &c. the day, &c. last, late unladen, and now in the *Dolphin*, Capt. *Henry Hoare*, for *Barbadoes*. Dated the 4th June, 1780.

This Certificate Cocket is gained by applying to the books of the importer, to know the day, &c, when the custom inwards was paid, and by whom; which carry to the long-room in the custom-house, and deliver it to the comptroller's clerk of the subsidy inward and outward, with an account of what you would export, &c.

A little before was mentioned at what key the goods should be landed, and therefore here it is proper to name the keys (or rather Quays) and wharfs that goods are usually landed at; which are these, *viz.*

Somer's key, Smart's key, Wiggin's key, Bear key, Dice key, Custom-house key, Potter's key, Wool key, Galley key, Brewer's key, Ralph's key, Chester's key, Lyon's key, Cox's key, Hammond's, Young's and Gaunt's keys. And the wharfs are fresh wharf and Botolph wharf.

Besides

Besides these, there are certain places called Docks, which are harbours cut into the land, where there is no current, but only a flow and ebb, occasioned by the rise and fall of the tide in the river Thames; and these are convenient for the lying of vessels, hoys, lighters, barges and boats; and are these, *viz.*

Billingsgate dock, Sabb's dock, Tower dock, St. Catherine's dock, Wapping dock, Hermitage dock, Execution dock, and Limehouse dock. And above bridge, Queenhithe dock, Puddle dock, White-Friars dock, and Scotland-Yard dock. And upon Southwark or Surry side, are Saviour's dock, Clink dock, and Savery's dock, below the Bridge-Yard, and several others for private uses. But more particularly eminent on that side of the water, is the Bridge-Yard for landing sundry sorts of merchandizes, but chiefly from the ports of England.

Of Wharfage and Lighterage.

WHarfingers have several managers over them, and also a committee to redress grievances, &c. and clerks of the stations, with lighter managers, and have the letting of many warehouses (which are now very fine and commodious, being re-built since the sad fire in Thames-street) cellars, &c. and have the privilege of keeping lighters for the carriage of goods to and from ships.

The Rates of Wharfage

Are generally computed at 12*d.* per ton, whether outward or inward; excepting sugar from the West-Indies, which pays 2*s.* per ton, 4 hogsheds being accounted a ton (though they weigh more) Crainage is included in the 12*d.* per ton wharfage, and for lighterage, the wharfingers have 12*d.* for 4 hogsheds of sugar that comes from the West-Indies; and for wine and other goods the lighterage is half as much as the wharfage.

Of

THE YOUNG MAN'S

OF ARITHMETIC.

HAVING thus given the reader a tolerable notion of the different forms of receipts, notes, bills of parcels, &c. to be used in business; We shall next proceed to Arithmetic the knowledge of which is so indispensably necessary, not only in trade, but in almost all the common affairs of life.

And first of Notation and Numeration.

In Notation we must observe, that all numbers are generally expressed by the ten characters following, viz.

One, Two, Three, Four, Five, Six, Seven, Eight, Nine, Cypher.

1 2 3 4 5 6 7 8 9 0

Nine of these are called significant figures, to distinguish them from the cypher, which of itself signifies nothing; but, as it is placed, it serves to encrease the value of the next figure or figures that stand before it; as 4 is but four; but before the cypher thus, 40, the 4 becomes forty, &c. — We are to note, that every one of the above nine figures or digits, has two values; one certain, and another uncertain, the certain value is, when it stands alone by itself; the uncertain is, when joined or placed with other figures or cyphers; for, when any one of these figures stands alone, it signifies no more than its own simple value; as 2 is but two, 3 but three, 4 but four, and 5 no more than 5, &c. And this is the certain value of a figure; but, when another figure or cypher is annexed, they are then encreased in their value ten times: as 2, or 2 units, or ones, to 2 tens, or twenty, 3 to 3 tens, or thirty, 4 to 4 tens or forty, and 5 to 5 tens or fifty; as thus, 21, twenty-one; 32, thirty-two; 43, forty-three; 54, fifty-four, &c. Again, if any of the said figures stand in the third place towards the left-hand, they then signify so many hundreds as singly they express units or ones; as 200 is two hundred, 300 three hundred, 400 hundred,

as units, tens, hundreds, thousands, &c. and apply them thus; 56, six units, six, and 5 tens, fifty, that is, fifty-six. Again, 456; 6 units, six; 5 tens, fifty, and 4 hundreds, four hundred; that is, four hundred and fifty-six. One more, 3456; 6 units, six; 5 tens, fifty; 4 hundreds, four hundred; 3 thousands, three thousand; therefore the sum together is, three thousand four hundred fifty-six. Read the 4th line from the top, *viz.* 123456789; here the valuation of the figures is from the right-hand to the left, as 1 in the ninth place is hundreds of millions, but to be read from the left hand to the right; thus, one hundred twenty-three millions, four hundred fifty-six thousand, seven hundred eighty-nine. But any number may be read yet more intelligibly, *viz.* by stops, thus; make a comma after every third figure or cypher, beginning at the right-hand, and proceeding on towards the left; distinguishing thereby every third place into hundreds, as hundreds of units, hundreds of thousands, hundreds of millions, and hundred thousands of millions, &c. Let us, for example, read the first line of the table; the last place in valuation is hundred thousands of millions, and to be pointed into divisions thus, 123,456,789,012; and read as follows, one hundred twenty-three thousand, four hundred fifty-six millions, seven hundred eighty-nine thousand, and twelve: that is, no hundreds, but twelve. Again, read the following number, *viz.* 276,245,678,921,460; here the first point or period is betwixt 4 and 1, and the last between 2 and 6, and to be read thus; 276 millions of millions, 245 thousands of millions, 678 millions, 921 thousands, 460 units or ones. The foregoing Table of Numeration is on the right-hand divided into periods, for the easier reading thereof; and the like is frequently done in the exchequer, bank, lottery tickets, &c.

Numbers to be read or writtem.

96, Ninety-six
 242, Two hundred forty-two.
 7924, Seven thousand nine hundred 24.
 54006, Fifty-four thousand and six
 524707, Five hundred twenty-four thousand 707
 4606240, Four millions 606 thousand 240
 62700471, Sixty-two millions 700 thousand 472
 474960204, Four hundred 74 millions 960 thousand 204
 4214007042, Four thousand 214 millions 7 thousand 42
 470706420042, Four hundred and 70 thousand 706
 millions 420 thousand and 42

Of Numerical Letters.

Sometimes numbers are expressed by letters; especially in the *Bible*, to signify the chapter or psalm; at the bottom of title pages of books, for the date of the year, and frequently in inscriptions on funeral monuments, &c. For which reason 'tis necessary to know how to read them. Therefore observe, that I. stands for 1, or an unit, II. for 2. III. for 3. IV. for 4. V. for 5. VI. for 6. VII. for 7. VIII. for 8. IX. for 9. X. for 10. XI. for 11. XII. for 12. XIII. for 13. XIV. for 14. XV. for 15. XVI. for 16. XVII. for 17. XVIII. for 18. XIX. for 19. XX. for 20. XXI. for 21. &c. XXX. for 30. XXXI. for 31, &c. XL. for 40. XLV. for 45, &c. L. for 50. LI. for 51, &c. LX. for 60. LXI. for 61, &c. LXX for 70. LXXI. for 71, &c. LXXX. for 80. LXXXI. for 81, &c. XC. for 90. XCI. for 91, &c. C. for 100. CC. for 200. CCC. for 300. CCCC. for 400. D. or I^o. for 500. DC. for 600, &c. M. or CI^o for 1000, &c. Thus the present year 1780 is wrote MDCCDXXX.

When a letter of inferior value stands after one of superior, its value is to be added thereto; thus, VI, VII, and VIII, signify six, seven, and eight. But when a letter of inferior value is placed before one

of superior, then its value is to be taken therefrom: thus, IV, IX, XL, and XC, signify four, nine, forty, and ninety.

A D D I T I O N.

IS the putting together two or more numbers or sums, so that their total value may be discovered or known.

Here we must always observe to set the numbers to be added, orderly one under the other; that is, units under units, tens, under tens, hundreds under hundred, &c. as in the subsequent examples.

Addition of Numbers of one Denomination.

Yards.	Gallons.	Pounds.
Tens Units	Hund. Tens Units	X of Th. Thous. Hund. Tens Units
2 4	7 5 6	5 7 3 6 2
4 2	4 3 2	3 9 7 4 4
6 8	5 7 8	6 7 2 2 2
8 6	6 9 6	7 9 6 7 4
2 4	4 2 2	. 2 4 9 2
4 2	6 7 8	. . 3 9 0
2 8 6	3 5 6 2	2 4 7 4 8 4

In Addition of simple numbers, whether it be yards, gallons, pounds, or any thing else, remember to carry 1, for every 10 you find in the row or rank of figures being units, to the next row of tens; and the like from the rank of tens to the row of hundreds, &c. and whatever it makes in the last row, you must set it down, amount to what it will. Thus:

The numbers above are set down in order, as before directed; that is, units under units, tens under tens, &c. as may be plainly understood, by being indicated at

at the head of each row or rank by units, tens, hundreds &c. Then in casting up each example, to know its total, I begin at the right hand, or units rank, of the first example, and say 2 and 4 is 6, and 6 is 12, and 8 is 20, and 2 is 22, and 4 is 26; in which row there are two tens and 6 over; wherefore I set down 6 just under its own rank, and carry two to the next row, and say, 2 that I carry and 4 make 6, and 2 is 8, and 8 is 16, and 6 is 22, and 4 is 26, and 2 is 28; and this being the last row, I set down the amount, *viz.* 28; so that the total number of yards is found to be 286. And the amount of the next or second example, is found by the same method to be 3562 gallons. And, in the third and last example, the total number of pounds is found to be 247484. And so the total of any other example of the same kind, *viz.* simple numbers of one denomination, may be found. *Note,* That when any of the ranks amount to just 10, 20, 30, 40, 50, &c. then you must set down the 0 under its proper rank, and carry either 1, 2, 3, 4, or 5, according to the number of tens that you find, to the next row. This you must always do in every row but the last, where the whole amount must be set down without any reserve or carriage in the mind, because there is no other row or rank to carry to, as was hinted before.

Addition of mix'd Numbers.

Note, 4 farthings make 1 penny; 12 pence make 1 shilling; 20 shillings make 1 pound sterling.

Libra in Latin signifies a pound; *l.* therefore stands for pounds.

Solidus in Latin signifies a shilling; *s.* therefore stands for shillings.

Denarius in Latin signifies a penny; *d.* therefore stands for pence.

Quadrans in Latin signifies a farthing; *q.* therefore stands for farthings.

L 3

Observe,

Observe, that pounds be set directly under pounds, shillings under shillings, pence under pence, and farthings under farthings.

But, before you proceed, get this Table of Pence by heart; thus, 30*d.* is half a crown, then 60*d.* is 5*s.* Again, 40*d.* is 3*s.* 4*d.* then 80*d.* is 6*s.* 8*d.* Again, 50*d.* is 4*s.* 2*d.* then 100*d.* is 8*s.* 4*d.* &c.

<i>d.</i>		<i>s.</i>	<i>d.</i>		<i>s.</i>	<i>l.</i>	<i>s.</i>
20	is	1	8		20	is	1 0
30	—	2	6		30	—	1 10
40	—	3	4		40	—	2 0
50	—	4	2		50	—	2 10
60	—	5	0		60	—	3 0
70	—	5	10		70	—	3 10
80	—	6	8		80	—	4 0
90	—	7	6		90	—	4 10
100	—	8	4		100	—	5 0
110	—	9	2		110	—	5 10
120	—	10	0		120	—	6 0

The use of these Tables is this: whenever you are casting up any sum of money, you begin at the right-hand (as before in sums of one denomination) suppose at the place of pence, then if the rank, row, or denomination of pence amounts, from the bottom to the top, to 56; your table of pence tells you, that 50*d.* is 4*s.* and 2*d.* to which adding 6*d.* the sum is 4*s.* 8*d.* If to 92*d.* the table tells you, that 90*d.* is 7*s.* 6*d.* which with 2*d.* over is 7*s.* 8*d.* And if to 81*d.* the table shews that 80*d.* is 6*s.* 8*d.* and 1*d.* more makes 6*s.* 9*d.* &c.

The Shilling Table serves to lead you to a quick recollection, how many pounds there are to so many shillings; as admit the rank of shillings arises to 57*s.* the table says that 50*s.* is 2*l.* 10*s.* and 7*s.* over make 2*l.* 17*s.* If to 84*s.* the table declares, that 80*s.* is just 4*l.* and 4*s.* over, make 4*l.* 4*s.* If to 112*s.* the table tells you that 100*s.* is 5*l.* and 12*s.* make 5*l.* 12*s.* &c.

Add-

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Addition of Money.

Money owing, and Money received as follows:

(1)			(2)		
Ow. to {	Mr. Adams	4 12 6	Rec- for {	Tobacco	46 10 9
	Mr. Brett	7 06 9		Sugar	79 16 0
	Mr. Cust	4 12 0		Indigo	42 18 3
	Mr. Dow	6 17 7		Broadcloth	66 12 4
	Mr. Eaton	5 06 6		Canary	90 16 0
	Mr. Franks	4 12 3		Port wine	84 07 6
	Mr. Green	6 00 0		Rice	24 12 0
	Mr. Hunt	5 15 4		Logwood	60 10 0
45 02 11			496 02 10		

I begin with the right-hand rank, that is the pence in the example of money owing, and say 4 and 3 is 7 and 6 is 13, and 7 is 20, and 9 is 29 and 6 makes 35 pence; now 30 pence, according to the table, is 2s. 6d. and 5d. more makes 2s. and 11d. I set down 11 exactly under the rank of pence, and say, 2 shillings that I carry (which I do to the rank of shillings) and 5 is 7, and 2 is 9, (for I take first only the units rank of shillings) and 6 is 15, and 7 makes 22, and 2 is 24, and 6 is 30, and 2 makes 32: and now being come to the top of the sum, and it making 32, I come down with the tens of shillings, saying 32 and 10 is 42, and 10 is 52, and 10 is 62, and 10 is 72, and 10 makes 82 shillings; and the table telling me that 80 shillings is 4 pounds, I know therefore 82s. is 4l. 2s. wherefore I set down the odd 2s. just under the row of shillings, and carry 4 pounds to the pounds; saying 4 that I carry and 5 is 9, and 6 is 15, and 4 is 19, and 5 is 24, and 6 is 30, and 4 is 34, and 7 is 41, and 4 makes 45 pounds; so that the total of those several sums of money, due to the several persons, amount to 45l. 2s. 11d.

In

In the example of money received, I begin at the right-hand rank as before, and say 6 and 4 is 10, and and 3 is 13, and 9 makes 22, and 22 pence being 1s. 10d. I set down 10 and carry 1s. to the shillings; saying 1 that I carry and 2 is 3, and 7 is 10, and 6 is 16, and 2 is 18, and 8 is 26, and 6 makes 32; then I come down with the tens, saying, 32 and 10 makes 42, &c. and find at the bottom it comes to 102 shillings, which makes 5*l.* 2s. I set down 2s. and carry 5*l.* to the pounds; saying, 5 that I carry and 4 is 9, &c. I find that at the Top it amounts to 56, whereof I set down 6 exactly under its own rank, *viz.* the rank of units of pounds, and carry 3 for the 3 tens that are in 30; for at all times in the addition of the left-hand denomination, whether it be money, weight, or measure, that is, in the denomination of pounds, tons, or yards, you must for every ten carry one to the next row, &c. saying, 3 that I carry, and 6 is 9, and 2 is 11, and 8 is 19, &c. and I find that at the top it comes to 49; &c. wherefore I set down 49 to the left-hand of the 6; and the total amount of the money received for those particular goods or wares sold is 49*l.* 2s. 10d.

More Examples for Practice.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
17	12	6 $\frac{3}{4}$	146	12	3 $\frac{1}{4}$	4	10	6
26	10	2	287	10	9	0	07	9
50	00	0	46	16	6	1	00	0
44	12	8 $\frac{1}{2}$	100	00	0	1	01	0
60	14	0	72	12	4	0	04	6
29	16	6 $\frac{3}{4}$	69	16	6 $\frac{3}{4}$	0	10	0
16	10	0	460	12	9	4	14	4
20	00	0	49	10	0	0	07	6
27	11	4 $\frac{1}{2}$	7	12	4 $\frac{1}{4}$	0	01	6
17	04	0	22	10	0	0	02	6
20	10	3	164	12	9	3	10	9
46	16	0	75	10	6	1	10	0
377	17	7	1503	16	8 $\frac{1}{4}$	18	00	4

Addition

Addition of Averdupois.

By this weight are weighed all kinds of grocery goods or wares, or goods subject to waste; as tobacco, sugars, fruit and drugs; as also flesh, butter, cheese, allum, tallow, iron, brass, copper, lead, tin, pewter, pitch, tar, rosin, hemp, flax, soap, salt, &c.

A Table of this Weight is as follows, &c.

4 Quarters make 1 dram, marked *qr.*

16 Drams 1 ounce *oz.*

16 Ounces 1 pound *lb.*

28 Pounds 1 quarter of a hundred weight, 112 pounds *qrs.*

4 Quarters 1 hundred weight *C.*

20 Hundred weight 1 ton *T.*

4 28		10 4 28		4 28		4 28		10 16 16	
<i>C. qrs.</i>	<i>lb.</i>	<i>C. qrs.</i>	<i>lb.</i>	<i>C. qrs.</i>	<i>lb.</i>	<i>C. qrs.</i>	<i>lb.</i>	<i>lb. oz. dr.</i>	
5	1 16—24	2	12	9	1 16	24	11 12		
4	2 24—42	2	00	4	3 26	42	14 15		
6	3 06—16	1	12	7	1 00	64	10 14		
7	1 12—25	3	24	5	3 27	29	09 10		
9	0 20—19	0	20	4	3 02	16	12 13		
6	2 00—26	1	22	2	2 02	27	13 14		

39 3 22 154 3 06 3 3 17 206 09 11

In these examples, the manner of proceeding is the same as in the former, observing that the number of units of each lesser denomination, which make an unit of the next greater, found by the preceding table, is placed above each rank of numbers; that is to say, in the first example, 28 the number of pounds contained in a quarter of an hundred weight, is placed over the column of pounds; now that column, when added up, makes 78, which contains two 28's and 22 over, wherefore 1 set down 22 under the column of pounds, and carry 2 to the column of quarters, and so on.

Note,

Note. That in weighing at the water-side, or elsewhere, they do not weigh by the tun, though some goods are sold by it, as iron, logwood, cheese, &c. but by the hundred, quarters, and pounds, which are afterwards reduced to and computed by tuns.

Addition of Troy Weight.

By this weight are weighed jewels, gold, silver, pearls, and medicines, and the usual denominations are pounds, ounces, penny-weights, and grains, as in the following table, *viz.*

24 Grains make 1 Penny-weight,
20 Penny-weights 1 Ounce, and
12 Ounces 1 Pound Troy:

Examples of Troy Weight.

6 Ingots of Silv. wt. viz.					10 12 20 24	12 20 24
No.	lb.	oz.	p.w.	gr.	lb. oz. p.w. gr.	oz. p.w. gr.
1 Wt.	4	05	12	10	14 06 10 11	204 10 14
2	5	04	16	17	24 10 11 12	96 07 17
3	3	11	19	20	21 06 04 17	100 11 12
4	4	06	07	12	22 10 12 14	56 16 20
5	5	01	11	12	16 11 12 13	212 10 23
6	4	11	12	13	22 07 06 17	96 19 12
					28 06 00 12	122 05 01 12
						767 17 02

If what was before said be duly observed, the performance of the above examples will be attended with no difficulty.

How

How to prove Addition.

IN all additions, whether of simple numbers, that is, numbers of one denomination; or in examples compound, that is of divers denominations, as pounds, shillings, pence, and farthings, &c. the readiest method of proof is to cast the sum downwards (beginning at the top as you did the same upwards, beginning at the bottom) and if that operation produces the same total, the work is certainly right; and this is much better, and more feasible than the common method used in schools, of making two totals, by omitting the upper line in the second. I might here also give several examples of other additions, such as apothecaries weight, cloth, liquid, dry and long measures, time, &c. but the same method serves for any of them, having respect to the tables belonging to those several denominations, which are as follow, &c.

A Table of the Parts of Apothecaries Weight.

20 Grains	1 Scruple.	℥ a Scruple.
3 Scruples	1 Dram.	ʒ a Dram.
8 Drams	1 Ounce.	℥ an Ounce.
12 Ounces	1 Pound.	℔ Pound.

By these weights they compound their medicines; but they buy and sell their Drugs by Avoirdupois weight.

Cloth

Clath Measure.

4 Nails, or 9 Inches,	1 Qr. of a Yard.
4 Qrs. or 36 Inches,	1 Yard.
5 Qrs. or 45 Inches,	1 Ell English.
3 Qrs. or 27 Inches,	1 Ell Flemish.
6 Qrs. or 54 Inches,	1 French Ell.

A Table of Wool Weight.

Note, 7lb. make 1 clove; 2 cloves, or 14lb. 1 stone; 2 stones, or 28lb. 1 todd; 6 todd and $\frac{1}{2}$, 1 wey, or 182lb. 2 weys, or 364lb. 1 sack; and 12 sacks 1 last, or 4368lb. 240lb. 1 pack of wool.

Note, that 1lb. 20z. 12pw. Troy, is equal to a pound Avoirdupois. And a pound Troy, is about 13 oz. 2 drams and a half Avoirdupois.

				<i>l.</i>	<i>s.</i>	<i>d.</i>
A pound weight Troy	}	of filver	}	3	02	2
A pound wt. Avoirdupois		is worth		4	15	3½
Wool.	}	in gold	}	1	11	¾
		in filver		26	04	
					} <i>Avoi. wt.</i>	

A pound Avoirdupois is heavier than a pound Troy; but an ounce Troy is heavier than an ounce Avoirdupois.

A Table of Liquid Measure.

Liquid measure is of two sorts, viz. one for wine, brandy, &c. and the other for beer and ale.

Wine Measure, &c.

8 Pints 1 Gallon	2 Hogheads 1 pipe or Butt.
42 Gallons 1 Tierce.	2 Pipes or Butts 1 Tun, or
63 Gallons 1 Hoghead.	252 Gallon.
84 Gallons 1 Puncheon.	

Note, That sweet oil hath 236 gallons to the tun; but oil from Greenland hath 252 gallons to the tun.

Note,

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Note, The wine gallon contains 231 cubic or solid inches, by which all liquids are measured, except beer and ale.

Beer Measure.

8 Pints 1 gallon	2 Kilderkins 1 barrel, or
9 Gallons 1 firkin of ale	36 gallons.
2 Firkins 1 kilderkin	1 Barrel and half, 54 gal-
	lons, 1 hoghead.

Ale Measure.

8 Pints 1 gallon	2 Kilderkins 1 barrel, or
8 Gallons 1 firkin soap,	32 gallons.
or herrings.	1 Barrel and half, or 48
2 Firkins 1 kilderkin.	gallons 1 hoghead.

Note, The Beer and Ale gallon are the same, viz. 282 solid inches; but the barrel of beer contains 1228 cubic inches, or 4 gallons, more than the barrel of ale.

In a Tun of Wine are

2 Pipes or butts.
6 Tierces
252 Gallons
504 Pottles
1008 Quarts
2016 Pints.

In a Pipe or Butt are

2 Hogheads
3 Tierces
126 Gallons
252 Pottles
504 Quarts
1008 Pints.

In a Puncheon are

84 Gallons
168 Pottles
336 Quarts
672 Pints

In a barrel of beer are

2 Kilderkins
4 Firkins
36 Gallons
72 Pottles
144 Quarts
288 Pints.

M

In

In a Hoghead are

63 Gallons
 126 Pottles
 252 Quarts
 504 Pints

In a Barrel of Ale are

2 Kilderkins
 4 Firkins
 32 Gallons
 64 Pottles
 128 Quarts
 256 Pints.

Dry Measure.

2 Pints 1 quart
 2 Quarts 1 pottle
 2 Pottles 1 gallon
 2 Gallons 1 peck

4 Pecks 1 bushel dry mea-
 sure

5 Pecks 1 bushel water mea-
 sure

4 Bushels 1 comb, or half-
 quarter

2 Combs 1 quarter

4 Quarters 1 chaldron

5 Quarters 1 wey

2 Weys 1 last or 10 quarts

4 Fatts, or vatts, or 36 bu-
 shels of sea-coal, 1 chal-
 dron; and 21 chaldrons
 is accounted a score in
 the river Thames.

Salt and sea-coal are heaped,
 or else there are 5 pecks to
 the bushel.

In the Last are

2 Weys
 10 Quarters

80 Bushels

320 Pecks

1280 Pottles

2560 Quarts.

5120 Pints.

In a Wey are

5 Quarters

40 Bushels

160 Pecks

320 gallons

640 Pottles

1280 Quarts

2560 Pints.

Note, By an act, Anno 1712, the bushel is 2178
 cubic inches, and a gallon of this measure is 272½
 cubic inches.

Long

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Long Measure.

8 Barley-corns	1 inch	6 Feet	2 fathom, or 2 yds.
12 Inches	1 foot	40 Poles, or 220 yards,	1 furlong
3 Feet	1 yard	8 Furlongs	1 mile, or 1760 yards
3 Feet 9 inches	1 ell Eng.	3 Miles	1 league.
5 Feet	a geometrical pace		
5 Yards and a half,	1 pole,		
perch, or rod.			

In a Mile are

8 Furlongs	5280 Feet
320 Poles	63360 Inches
1760 Yards	190030 Barley-corns.

Land Measure.

5 Yards and a half,	1 pole, perch, or rod.
40 Poles	make 1 furlong, or quarter of an acre.
160 Poles in length,	and 1 in breadth, is 1 acre.
80 Poles in length,	and 2 in breadth, 1 acre; and
40 Poles in length,	and 4 in breadth, 1 acre.
4 Poles in length	make 1 chain.
10 Chains in length,	and 1 in breadth, make 1 acre.

Time.

60 Seconds	1 minute	In a Year are
60 Minutes	1 hour	
24 Hours	1 natural day	31557600 Seconds
7 Days	1 week	525960 Minutes
4 Weeks	1 month	8766 Hours
13 Months, 1 day, and 6 hours,	1 solar year.	365 Days 6 hours

M 2

Note,

Note, The solar year is divided into 12 calendar months, which contain 365 days, according to this good old distich, viz.

*Thirty Days hath September, April, June and November,
February hath 28 alone, and all the rest have Thirty-one.*

SUBTRACTION.

THE next Rule in Arithmetic is Subtraction, which takes a lesser number from a greater, and leaves the difference.

In order to perform the operations in this rule aright, you must place the lesser number under the greater (with the same care, and in the same order as in addition) and draw a line under them, and beginning at the right-hand, take each figure in the lower line from the figure under which it stands; but if the figure in the lower line is greater than that in the upper, then in numbers of one denomination, ten must be borrowed and added to the figure in the upper line; then take the figure in the lower line from the sum, and write down the remainder; but for every ten thus borrowed, one must be paid or added to the next left-hand figure in the lower line. *Example;* suppose Mr Adam owes Mr Brown 323*l.* whereof Mr. A. hath paid to Mr. B. the sum of 146*l.* in part; what remains due to Mr. Brown?
— Answer, 177*l.*

177*l.*

Here the lesser number 146 stands under the greater 323; and to find the remainder, or sum remaining due, I say 6 from 3 I cannot, but 6 from 13 (for you borrow 10 and add it to the figure or cypher that stands directly over the figure you subtract) and there remains 7; then 1 that I borrowed and 4 is five, for as I borrowed 10 in the inferior place, which is equal to one in the superior, so I must now pay the same; therefore I say, 5 from 2 I cannot, but 5 from 12 (borrowing 10, and adding it to the figure 2, as above directed) and there remains 7; then 1 that I borrowed and 1 is 2, from 3 the figure above it, and there remains

remains 1, and so the question is done; and by it is shewn that A still owes B. 177 pounds. To prove that is right, add 177 the remainder, to 146, the lesser of the two given numbers, and it will make 323, which is the same with the greater number, or sum of money first due; and consequently is a sure proof of the certainty of the rule. And as Subtraction is proved by Addition, so may Addition be proved by subtraction; for if the two aforesaid numbers, viz. 323 and 146, are added, their total is 469; from which if you deduct 146, the remainder will be the greater number; or if you subtract 323 from the said 469, the remainder will be 146 the lesser number.

All questions in Subtraction of numbers of one denomination are performed as above. However the better to illustrate the rule, I shall give a few more examples. Suppose a great sheep-master hath in all 6904 sheep, and takes out of them 2490 to dispose of at market, how many doth he leave behind? To know this set them down thus:

From—6904 the greater number,
Take—2490 the lesser number.

Answer 4414

Here I say 0 from 4 and there remains 4; then 9 from nothing (or 0) I cannot; but 9 from 10 (adding 10 to the 0) and there remains 1; and 1 that I borrowed and 4 makes 5, and 5 from 9 and there remains 4; and lastly, 2 from 6 and there remains also 4 (for I borrowed none, and therefore there is no occasion of paying) so that he leaves behind him just 4414, which put to the number he takes to market, makes the number he had, viz. 6904, and shews the deduction to be true, and the answer right.

More Examples for Practice.

	Pounds.	Yards.	Gallons.	Busbels.
From	6274	7328	56789	827493
Take	<u>4985</u>	<u>5167</u>	<u>37894</u>	<u>238514</u>
Rem.	<u>1289</u>	<u>2161</u>	<u>18895</u>	<u>588979</u>
Proof	<u>6274</u>	<u>7328</u>	<u>56789</u>	<u>827494</u>

The distance of time since any remarkable event, may be found by subtracting the date thereof from the present year.

Examples.

I.—1780
1066 The Conquest.
 714 Years since

II.—1780
1535 The Reformation
 245 Years since.

III.—1780
1688 The Revolution
 92 Years since.

Subtraction of Divers Denominations.

Here, if the figure or figures, placed in the lower line, exceed those in the upper, then as many units must be borrowed; as make a unit, or one, of the next superior denomination; and one must be carried to the next left-hand place in the lower line, as before.

Of

Of Money.

	<i>l.</i>	<i>s.</i>	<i>d.</i>	
Due—	9	02	6	Suppose Mr. Cust owes Mr.
Paid—	6	16	4	Day, 9 <i>l.</i> 2 <i>s.</i> 6 <i>d.</i> and Mr. C. hath
				paid Mr. D. in part, 6 <i>l.</i> 16 <i>s.</i> 4 <i>d.</i>
				what remains due to Mr. Day?
Rests due	2	06	2	Answer, there is due to Mr. Day
				2 <i>l.</i> 6 <i>s.</i> 2 <i>d.</i>

	<i>l.</i>	<i>s.</i>	<i>d.</i>	
Sold for—	242	16	3 $\frac{3}{4}$	Again, Mr. Elliot sells
Paid in part	174	12	6 $\frac{1}{2}$	to Mr. Frost, Spanish wool,
				to the value of 242 <i>l.</i> 16 <i>s.</i>
				3 <i>d.</i> $\frac{3}{4}$, and pays present mo-
Answer—	68	03	9 $\frac{1}{4}$	ney the sum of 174 <i>l.</i> 12 <i>s.</i> 6 <i>d.</i> $\frac{1}{2}$.
				what money remains unpaid
				from Mr. Frost? Answer,
				68 <i>l.</i> 3 <i>s.</i> 8 <i>d.</i> $\frac{1}{4}$.

In the first of these examples I say, 4*d.* from 6*d.* and there remains 2*d.* then 16*s.* from 2*s.* I cannot, but borrowing one integer of the next denomination, or 1 pound, which is 20*s.* I say 16 from 20, and there rests 4, and adding thereto the number 2 it makes 6; wherefore I put down 6 in the place of shillings, and say, 1 that I borrowed and 6 is 7; now 7*l.* from 9*l.* there remains 2*l.* so the money resting due to Mr. Day, is 2*l.* 6*s.* 2*d.* as in the example.

In the second example, I say, 2 farthings (or an half-penny) from 3 farthings, and there remains 1 or $\frac{1}{4}$, which I set down in its proper place, viz. under the denomination of farthings; then 6 from 3 I cannot, but 6 from 12 (as marked over the denomination) and there remains 6, and 3*d.* over it makes 9*d.* which I place under the line in its right place, viz. of pence; then 1 that I borrowed (that is 1 shilling) and 12 is 13; 13*s.* from 16*s.* and there rests 3, which I likewise set down under its own rank; then 4 from 2 I cannot, but 4 from 12, (borrowing 10) and there rests 8; then 1 that I borrowed and 7 makes

THE YOUNG MAN'S

makes 8; 8 from 4 I cannot, but 8 from 14, and there remains 6; and 1 that I borrowed and 1 makes 2 from 2 and there remains nothing; so that the sum remaining due is 68*l.* 3*s.* 9*d.* $\frac{1}{4}$. as in the work. For its proof, you must add the remainder, 68*l.* 3*s.* 9*d.* $\frac{1}{4}$, to the lesser or under sum, 174*l.* 12*s.* 6*d.* $\frac{1}{2}$, and it makes 242*l.* 16*s.* 3*d.* $\frac{3}{4}$, the sum first due, which shews the work to be right.

More Examples for Practice.

	10	20	124	10	20	12	10	20	124
	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
Due—	174	16	6 $\frac{1}{2}$	74	10	4	2471	07	0
Paid—	97	12	4 $\frac{3}{4}$	29	12	9	1976	16	6 $\frac{1}{2}$
Remain—	77	04	1 $\frac{1}{2}$	44	17	7	494	10	5 $\frac{1}{2}$
Proof—	174	16	6 $\frac{1}{2}$	74	10	4	2471	07	0

	10	20	12	10	20	12	10	20	124
	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
1st Due—	74	00	00	274	16	6	796	00	0
Paid—	46	12	10	197	19	4	279	11	7
Balance—	27	07	02	76	17	2	516	08	5
Proof—	74	00	00	274	16	6	796	00	0

Sometimes a sum owing may be paid at several times; then the several payments must be added together, and their total deducted from the sum Paid at times first due as in this and the examples following.

Owing	450 <i>l.</i>
	60
	32
	25
	47
	58
	20
	36
Paid in all	278
Remains due	172
Proof	450

More

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	<i>l.</i>	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>	<i>d.</i>
More due	249	12	0	Received	100	10	0
Received at several times	24	12	6	Paid to seve ral persons	6	16	0
	9	14	9		10	00	0
	20	00	0		5	12	6
	16	16	6		20	10	0
	22	10	2		7	09	6
	13	12	6		9	08	6
	7	16	4		7	12	6
Received in all	115	02	9	Paid in all	67	09	0
Rests due	134	09	3	Remains in the bag,	33	01	0
Proof	249	12	0				

Avoirdupois Weight.

	<i>10</i>	<i>20</i>	<i>4</i>	<i>28</i>		<i>10</i>	<i>4</i>	<i>28</i>		<i>10</i>	<i>16</i>	<i>16</i>
	<i>Tons.</i>	<i>C.</i>	<i>qrs.</i>	<i>lb.</i>		<i>C.</i>	<i>qrs.</i>	<i>lb.</i>		<i>lb.</i>	<i>oz.</i>	<i>dr.</i>
From	44	12	1	10		246	2	12		146	02	10
Take	39	14	2	06		164	3	22		97	10	12
	4	17	3	04		81	2	18		48	07	14
Proof	44	12	1	10		246	2	12		146	02	10

Troy Weight.

	<i>10</i>	<i>12</i>	<i>20</i>	<i>24</i>		<i>10</i>	<i>20</i>	<i>24</i>
	<i>lb.</i>	<i>oz.</i>	<i>pwt.</i>	<i>gr.</i>		<i>oz.</i>	<i>pwt.</i>	<i>gr.</i>
From	462	04	10	11		1247	10	12
Take	196	09	06	16		976	16	17
Remain	265	07	03	19		270	13	19
Proof	462	04	10	11		1247	10	12

And so much for Subtraction; which method will serve for any denomination whatever, respect being had to the several tables of quantity, as before hinted in Addition.

MULTI

MULTIPLICATION.

THE next rule in order is Multiplication; which, on account of its quick dispatch in business, is perhaps the most useful rule in Arithmetic, as will appear from the following particulars.

1. Multiplication is a rule, that by two numbers given, teacheth to find out a third, which shall contain either of the two, as many times as the other containeth an unit.

2. Multiplication is also a compendious working of Addition.

3. It serves likewise to bring great denominations into small, as pounds into shillings, pence, or farthings.

4. Having the length and breadth of a plain surface, we find its content in superficial or square measure.

5. By Multiplication, if we have the value of one thing, or the wages of one person, we can easily find the value of many such things, or the wages of many such persons.

In Multiplication we are particularly to take notice of these three terms, *viz.*

The { Multiplicand,
Multiplier, and
Product.

1. The Multiplicand (generally the greater of the two numbers) is the number to be multiplied.

2. The Multiplier (generally the lesser of the two numbers) is the number by which the former is to be multiplied.

3. The product is the result of the work, or answer. The Multiplier and the Multiplicand are collectively called Factors.

But before we proceed farther, it is necessary to have the following Table by heart, and that very perfectly.

The

The Multiplication Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

This table is so plain and easy, that there is no need of direction; for the product of any two figures will be found in that square, which is on a line with the one, and under the other; thus 54 the product of 6 and 9, will be found on a line with 6, and under 9, or in a line with 9, and under 6; so 7 times 8 is 56, and 8 times 7 is 56, &c. And thus the table ought to be got by heart for the greater readiness in multiplying.

Now for application.

Example 1. How many is 3 times 472? which 472 being set down in the margin; I say, 3 times 2 is 6, which place under 2 the multiplier; then 3 times 7 is 21; set down 1 under 7, and carry 1416 2 for the 2 tens, as in addition of one denomination, then 3 times 4 is 12, and 2 carried is 14; which set down, and the product is 1416. *Exam-*

Example 1. What is the amount of 3 times 654?

Answer; If you set the number 654, 3 times down on paper, one over another, and add them together, the total will be 1962.

But such questions are done much more readily, by this rule of Multiplication. Set the numbers down thus:

654 Multiplicand
3 Multiplier.

Now to know how much 3 times 654 is, begin thus, saying 3 times 4 is 12, the figure 2 of the 12 set below the line, and bear the 10 of the 12 in mind, as 1; next, 3 times 5 is 15, and 1 that I bore in mind, makes 16; so I set the 6 below the line, and 654 bear the 10 in mind as 1; next, I say 3 times 6 is 18, and 1 I bore in mind makes 19, which I set down, and the work will stand as in the margin. 1962

Example 2. How many is 3 times 472? Set 472 the figures down as in the margin; then say, 3 times 2 is 6, which place under the 2 in the multiplicand; then 3 times 7 is 21; set down 1 under 7, and carry 2, for two tens, as in addition of one denomination; then 3 times 4 is 12, and 2 is 14; which set down, and the product is 1416, that is, 3 times 472 makes so much; as may be proved by Addition, by setting down 472 three times in additional order, and casting it up, which makes the assertion good in the second definition, that this rule compendiously performs the office of Addition. Likewise the foregoing examples agree with the first definition; for, as 3 times 472 makes 1416, so doth 472 times 3 make the same, viz. 1416.

Exam-

Example 3. Again, how many makes 742 multi-
plid by 4?

742 Multiplicand.	} Here I say 4 times 2 is 8, and 4 times 4 is 16; 6 and carry 1; and 4 times 7 is 28, and 1 is 29, which I set down; so the whole product is 2968, as <i>per</i>
4 Multiplier.	
2968 Product.	

Example.

More examples of one figure in the Multiplier :

Multiplicand.	6748	5293	7489
Multiplier.	4	5	6
Product.	26992	26465	44934

Compound Multiplication,

Is when the Multiplier consists of more figures than one; and here you must begin with that figure which is in the place of units of the multiplier, and go thro' the whole Multiplicand, by multiplying each figure of it first by the said unit figure, then by the next, to wit, by the figure in the place of tens of the Multiplier, then with the third, &c to the last; always remembering to place the first figure of every product or line, (for you will ever have as many as you have significant figures in the Multiplier) I say, remembering to place the first figure of each line exactly and perpendicularly under the figure you multiply by; and then add the several lines or products together, which, so collected, give the total product required, as in the examples following, *viz.*

N

Example

Example.

How many are 23 times 7426? First, I begin 7426 with the unit figure 3 in the Multiplier, saying, 3 times 6 is 18; 8 (which I set directly under 3, by which I multiply) and carry 1; 22278 and 3 times 2 is 6, and 1 is 7; then 3 times 4 is 12; 2 and carry 1; then 3 times 7 is 21, and 1 is 22. And so I have done with the first figure of the Multiplier, viz. 3. Then I go to the next, that is 2, twice 6 is 12; 2 and carry 1; (which 2 is placed in a direct line under 2 the multiplying figure) then twice 2 is 4, and 1 is 5; then twice 4 is 8; and lastly, twice 7 is 14, which I set down: Then I add the two products together, saying, 8 is 8, &c. and the total is the true product, or result of the Multiplication, viz. 170798.

To know how many hours there are in one year.

There are 365 days in a year, and 24 hours in a day, therefore I multiply 365 by 24, and to do that I set them thus:

$$\begin{array}{r} 365 \\ 24 \\ \hline 1460 \\ 730 \\ \hline \end{array}$$

8760 hours in a year.

Then I proceed to multiply, saying 4 times 5 20, and set down the cypher under 4, and carry the two tens to the next place, saying 4 times 6 is 24, and 2 that I carry is 26; wherefore I set down the 6 under the figure 6, and carry the two tens to the next place, saying 4 times 3 is 12, and 2 that I carry is 14, which I set down.

Having

Having multiply'd the 365 by the figure 4, then I proceed to multiply it by the figure 2 of the 24, the Multiplier, after the same manner as I did the figure 4:

Saying, 2 times 5 is 10, set a cypher under the 2, because 1 multiply by 2, and bear 1 in mind. Next, 2 times 6 is 12, and 1 I bore in mind is 13, and the 3 of the 13 I set under the 4, and bear 1 in mind. Lastly, 1 say 2 times 3 is 6, and 1 that I bore in mind makes 7, which 7 I set under the 1; and now having done multiplying, to finish the work, I add those two numbers together, viz. the 1460 and 730, just as they stand; and they amount to 8760, as you may see in the example.

If there be 8760 hours in one year, as in the last example, the next question is, how many minutes are there in 8760 hours.

Hours in one year	8760
Minutes in one hour	60
	525600

Note, That you are to observe to set the 6 of the 60 just under the last figure of the Multiplicand, next the right-hand, and the cypher 0 by itself; the same ought to be observed, if the Multiplier had been 600, or 6000, or 10, 100, or 1000, &c.

Now for the resolving this question, begin thus; the cypher 0 I set under the line. Next, 6 times 0 is 0, which 0 I set under the line under the 6; next, 6 times 6 is 36, and the odd 6 of the 36 I set under the line, and bear three in mind for the 30, saying, 6 times 7 is 42, with the 3 I bore in mind, make 45, the odd 5 I set between the lines, and bear four tens in mind.

Lastly, 6 times 8 is 48, with the 4 I bore in mind makes 52; and the odd 2 I set under the line, and the 5 of the 52, (having no farther to carry it) I set it also under the line, and the whole sum is 525600, as above.

N 2

If

If there are 525600 minutes in a year, how many minutes old may a young man be, that is 23 years of age? Set the question down thus:

525600 Minutes in a year.
23 Years old.

Saying, 3 times 0 is 0, and set that under the 3; next, 3 times 0 is 0, and set that under the 2; next, 3 times 6 is 18, I set the odd 8 under the line, and bear 1 in mind; next, 3 times 5 is 15, and the 1 I bore in mind makes 16, the odd 6 I set under the line, and bear 1 in mind, and say 3 times 2 is 6, and the 1 I bore in mind makes 7, which I set under the line. Next, I say 3 times 5 is 15, which 15 I set under the line, and the figure 3 of the multiplier is done with.

Next, multiply by the figure 2 of the multiplier, saying, 2 times 0 is 0, (which 0 I set just under the figure 2, as you may see below:) next, 2 times 0 is 0, which I set under the figure of 8; next, 2 times 6 is 12, (the 2 of the 12 under the 6) and bear 1 in mind. Next, 2 times 5 is 10, and the 1 I bore in mind, makes 11, the odd 1 I set under the 7, and bear 1 in mind. Next, 2 times 2 is 4, and the 1 I kept in mind, makes 5, which I set under the 5; 2 times 5 is 10, which set down as you see underneath.

Minutes in a year	—	525600
Years of his age	—	23
		1576800
		1051200
Minutes old	—	12088800

Now I have done multiplying, and the two lines produced being added together, make 12088800; so that a young man of the age of 23 years may be said to be twelve millions, 88 thousand, 8 hundred minutes old.

Note, 365 is set for the days of a year above, yet the *Julian* account makes it to consist of six hours more. There-

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Therefore I multiply 6 by 23, the young man's age in years, and it makes 138 hours; this multiplied by 60, the minutes in an hour, makes 8280 minutes to be added to

12088800 Minutes.

8280

Which makes in all 12097080 minutes in 23 years.

Again, What is the product of — 527527
Multiplied by — 285

2637635

4220216

1055054

150345195

More Examples.

527535

15728

4220280

1055070

3692745

2637675

527535

8297070480

275827

19725

1379135

551654

1930789

2482443

275827

5440687575

When cyphers are intermixt with figures in the multiplier, then multiply by the figures as above: and when you come to a cypher in the multiplier, set down another cypher exactly and perpendicularly under it; then begin the multiplicand again with the next figure to the cypher in the multiplier, and go through it in the same line, placing the first figure of that product next to the cypher towards the left hand; but then care must be taken, that the next figure or cypher of the next line be set down one

N 3

degree

degree farther towards the left hand, and not immediately under the last figure set down next to the cypher: As in the following examples may be fully understood.

24393	7864371	327586
402	23604	6030
48786	31457484	9827580
975720	471862260	19655160
	23593113	
9805986	15728742	1975343580
	185630613084	

When you have a cypher or cyphers in the multiplier at the beginning towards the right hand; then set it or them backwards from the place of units towards the right hand; and when you have multiplied by the figure or figures, annex the cypher or cyphers:

As in these Examples.

4762	47962	4632
70	400	2600
333340	19184800	2779200
		9264
		12043200

If you have cyphers in the units place, &c. both in the multiplicand and multiplier, then neglect the cyphers in both, and multiply by the figures, and annex as many cyphers to the total product as is the sum of the cyphers, both in the multiplicand and multiplier:

As

As in these Examples.

42600	42300	376400
220	12000	2400
852	648	15056
852	324	7528
9372000	507600000	903360000

When you are to multiply by 10, 100, 1000, or 10,000, it is only adding or annexing so many cyphers to the multiplicand as are in the multiplier, that is, either 1, 2, 3, or 4 cyphers, and the work is done. *Example*, Suppose I am to multiply 375 by the numbers above; if I multiply it by 10, then I join 0 to 375, and it makes 3750: If by 100, then I annex 00, and it makes 37500: If by a 1000 I put to it 000, and then it produces 375000: And lastly, if by 10,000, I then add 0000, and it makes 3750000, &c. And thus may any number be multiplied, when the multiplier consists of an unit with any number of cyphers.

These directions may suffice for the manner of multiplying in general. The next thing is to shew the use of multiplication in real business, and how to apply it on proper occasions: thus,

1. Suppose you want to know how many half-crowns there are in 246l. you know that 8 half-crowns make a pound; wherefore set them down thus:

246l.
Multiply by — 8 the half crowns in a pound.

Answer — 1968 Half crowns in all.

Again, In 1968 Half crowns, how many pence?
Multiply by 30 the pence in a half crown.

Answer 59040 Pence in 1968 half crowns.

And

And this serves to shew, that great denominations are brought into smaller by this rule.

2. Suppose you wanted to know the contents of a large shuffle-board table 34 feet long, and four feet wide.

Multiply 34 the length
by 4 the breadth, and the

Answer will be 136 square feet for the true contents of such a table.

3. If I know the value of a yard of broad-cloth to be 12 shillings, what is the value of 220 yards of the said cloth in shillings?

220
Multiply by 12

440
220

Answer 2640 Shillings, or 132*l*.

4. If the wages of one seaman be 23 shillings a month, what are the wages of 250 seamen for the same time.

250
Multitply by 23

750
500

Answer 5750 shillings, or 287*l* 10*s*.

5. How

5. How many barley corns will reach from London to Bedford, if these places are 40 miles asunder?

First set down the whole distance, viz. 40 miles.

Then multiply by 8, the furlongs in 8 a mile,

And the product is 320 furlongs

Multiply this by 40, the poles in 40 a furlong,

And the product is 12800 poles

Multiply this by 11, the $\frac{1}{2}$ yards in a pole,

12800
12800

And the product is 140800 $\frac{1}{2}$ Yards.

Multiply this by 18, the inches in a half yard,

1126400
140800

And the product is 2534400 Inches

Multiply this by 3, the barley-corns in an inch,

And the product is 7603200 B. Corns

in 40 miles, the distance from London to Bedford.

6. Suppose it was asked, how many barley-corns in length will reach from London to York, which is commonly accounted to be 150 miles.

First set down the 150 miles, and multiply as in the last question, and you will find the last product to be 28 millions, 512 thousand barley corns.

Note, An English mile is 8 furlongs (as above.)

A Scottish and Irish mile, about one mile and an half English.

A Dutch and Polish mile, three English miles and an half.

A French, Italian, and Turkish league, near 2 English miles and 3 quarters.

A

A German mile is somewhat more than 4 English miles.

The Russian mile, about 3 quarters of an English mile.

The Arabian mile, an English mile and a quarter.

The Hungarian mile is 5 miles English.

The Moguls mile, a mile and a half English.

7. If the wages of one seaman be 14s. a month, what will the wages of 3349 seamen, for the same time come to?

$$\begin{array}{r}
 3349 \\
 14 \\
 \hline
 13396 \\
 3349 \\
 \hline
 46886 \text{ Shillings.}
 \end{array}$$

The answer is 46886 shillings, which you may reduce into pounds by the second example in reduction.

8. If an orchard contains 10 squares, and every square have 10 trees, and every tree 10 branches, and every branch 10 apples, how many apples are there in the orchard? I answer, ten thousand, viz.

The number of squares _____ 10

The trees in one square _____ 10

The trees in all _____ 100

The branches in a tree _____ 10

The branches in all the trees _____ 1000

The apples on a branch _____ 10

The apples in the whole orchard 10000

And thus much for Common Multiplication. I shall next say something of Multiplication of Money, and its various uses, and so conclude this rule.

Multi-

Multiplication of Money.

Multiplication of money (which most people should learn above every thing else) hath great affinity with addition of money; the same method being observed in carrying from one denomination to the next, *viz.* from farthings to pence, from pence to shillings, and from shillings to pounds. And as in addition, (and other multiplications) you begin at the right-hand, and proceed towards the left; so here you begin at the lowest denomination, which is also at the right-hand.

This method of accompting is the most easy and expeditious of any, for smaller quantities: and therefore extremely necessary in making bills of parcels, &c. And it is, beyond contradiction, as sure and certain as any way whatsoever.

The general Rule

Is always to multiply the price by the quantity.

The first step is, for quantities from 2 to 12; and this is done by the multiplier; as in the examples following.

Example 1. What must I give for six pieces of cloth, if one piece cost 7*l.* 12*s.* 6*d.*

<i>l.</i>	<i>s.</i>	<i>d.</i>
7	12	6

Multiply the price by 6

And the product is the answer, *viz.* £. 45 15 0

Here I say 6 times 6 is 36 pence, which is just 3*s.* I set I set down 0 in the place of pence, and carry 3*s.* to the place of shillings, (exactly the same as in addition of money) then 6 times 12 is 72, and 3 is 75*s.* or 3*l.* 15*s.* wherefore I set down 15 in the place of shillings, and carry 3 to the pounds; then 6 times 7 is 42 and three is 45*l.* So the whole amount of the 6 pieces of cloth, at 7*l.* 12*s.* 6*d.* per piece, is 45*l.* 15*s.* as in the work, which is very concise.

Example

Example 2. How much is 9 times 13s. 4d. or what is the amount of 6 Marks?

$$\begin{array}{r}
 \text{s. d.} \\
 13 \ 4 \\
 \text{Multiply by} \quad 9 \\
 \hline
 \text{Answer} \quad \text{£.} 6 \ 0 \ 0
 \end{array}$$

In this example I say, 9 times 4 is 36d. or 3s. I set down 0, and carry 3; then 9 times 3 is 27, and 3 makes 30; I set down 0, and carry 3, (as in multiplication of simple numbers;) then 9 times 1 is 9, and 3 is 12; which is in the place of tens of shillings, and being halved, make just 6l. and so much is the value of 9 Marks.

Example 3. What come 12 gallons of wine to, at 5s. 4d. per gallon?

$$\begin{array}{r}
 \text{s. d.} \\
 5 \ 4 \\
 \text{Here I say 12 times 4 is 48, 0 and carry} \quad 12 \\
 4; \text{ then 12 times 5 is 60, and 4 is 64s. or} \quad \text{---} \\
 3l. \ 4s. \quad \text{£.} 3 \ 4 \ 0
 \end{array}$$

The next degree or step of advance in this way of reckoning, is of quantities exceeding 12, even to 12 times 12, or 144; all which, as far as 144, are found in that excellent table, the table of multiplication; which is a ready help in all manner of reckoning, and particularly of this kind; and that you may proceed with ease, you must be very perfect in the said table, that you may know immediately what component parts hit the quantity proposed, or pretty near it; (for any quantity below 12 needs no recollection at all, as in two of the examples foregoing) and then work accordingly. If the quantity be 15 yards, I readily know that 3 and 5, or 5 and 3, are to be my multipliers. If the quantity be 21, then 3 and 7, or 7 and 3 will be the multipliers. If 30, then 5 and 6, also 3 and 10, or 10 and 3. If 45, 48, 56, 66, 72, 96, &c. then 5 and 9, 6 and 8, 7 and 8, 6 and 11, 6 and 12, 8 and 12, &c. are to be multipliers, and exactly hit their several quantities of which they are component parts; and the examples of this kind have two multiplications for their solution.

When

When the quantity proposed is a number irregular, or such a number, that no two numbers in the table can be found to answer it, then we must multiply by two such numbers as come pretty near it, as is said above; and for the number wanting to make up the number or quantity proposed, multiply the given price by the number that is wanting, which will make three products, by three multiplications; which last product must be added to the foregoing products resulting from two multiplications, and the total will be the answer.

And first, I shall give examples of the second step, *viz.* of regular quantities that exceed 12, and are precisely answer'd at two multiplications, such as mentioned above, *viz.*

Example. What comes 15 yards of Holland to, at 3s. 5d. per yard?

Here 3 times 5 is 15d. or 1s. 3d. 3 s d.
 and carry 1s.; then 3 times 3 is 9, and 3 5
 1 is 10s. so the first product is 10s. 3d. 3 and 5
 which I multiply by 5, saying, 5 times 10 3
 3 is 15d. or 1s. 3d. 3 and carry 1; then 5
 5 times 10 is 50, and 1 is 51s. or 2l. 11s. 2 11 3
 So the whole amount of 15 yards, at 3s. 5d. per yard, is 2l. 11s. 3d. And de-

monstrable thus, *viz.* If 10s. 3d. be the value of 3 times 3s. 5d. then 5 times the value of 10s. 3d. must of necessity be 15 times the value of 3s. 3d. because 5 times 3 is 15; And its truth may be proved by addition and multiplication thus: Set down 3s. 5d. 3 times, in additional order, and put the three lines together, and the total of them multiply by 5, as before, and the answer will be the same. Or set down 17s. 1d. (the product of 3s. 5d. multiplied by 5) 3 times also, and add them together, and the total will be exactly the same with the result by multiplication, as in the following specimen of the work.

(1)	(2)	(3)
s. d.	s. d.	s. d.
3 5	3 5	17 1
3 5	5	17 1
3 5		17 1
10 3	17 1	2 11 3
5		
2 11 3		

Here the first of these two proofs is worked by addition and multiplication, and the second by multiplication and addition. Also,

By this we see, that in all examples under this head, we are to find two numbers (for multipliers) in the table; which multiplied together, make the quantity proposed; and then we are to multiply the price by one of the numbers (it matters not which) and then that product is to be multiplied by the other number, and the second or last product will be the answer.

Example 2. What is the value of 21 gallons of Rum, at 7s. 9d. per Gallon?

s. d.
7 9
7 and 3
2 14 3
3
8 02 9

In this example I say, 7 times 9 is 63d. or 5s. 3d. I set down 3 and carry 5; then 7 times 7 is 49, and 5 is 54s. or 2l. 14s. So the first product is 2l. 14s. 3d. which I multiply by 3, and that produces the last product or answer, 8l. 2s. 9d.

More

More Examples without any verbal directions.

Example 3. What comes 30 ells of Muslin to, at 3s. 7d. per ell?

s. d.
3 7
10 and 3

1 15 10
3

Answ. 5 07 06

Example 4. 45 pounds of raw Silk, at 15s. 6d. per pound.

s. d.
15 6
5 and 9

3 17 6
9

Answ. 34 17 6

Example 5. 56 bushels of Wheat, at 4s. 9d. per bushel.

s. d.
4 9
7 and 8

1 13 3
8

Answ. 13 6 0

O 2

Example

Example 6. 72 Broad Pieces, at 23s. 6d. each.

s. d.
23 6
12 and 6

14	2	0
		6

Ans^w. 84 12 0

Example 7. 108 pounds of Indigo, at 7s. 8d. per pound.

s. d.
7 8
9 and 12

3	9	0
		12

Ans^w. 14 8 0

Example 8. 96 C. of Currants, at 2l. 13s. 6d. the C.

l. s. d.
2 13 6
8 and 12

21	8	0
		12

Ans^w. 256 16 0

The

The next step of advance is of quantities irregular, or of numbers that are not to be answer'd precisely at two multiplications: In this case there is no greater difficulty than in the examples foregoing; only here you will have an addition of one line more, occasioned by bringing down the price of one to be added to the last product; or else a line more made by multiplying the price by what is wanting in the number by two multiplications, to make up the proposed quantity compleat; as it may be of 2, 3, 4, 5, &c. this will be evident from the following examples.

Example 1. What is the product of 2*l.* 13*s.* 6*d.* multiplied by 39?

Here I find that 6 multiplied by 6 makes 36; which is within 3 of the quantity proposed; wherefore I multiply by 6, and that product again by the other 6; the last product is 96*l.* 6*s.* which is the product by 36; but we want to know the product by 39; wherefore I multiply the

<i>l.</i>	<i>s.</i>	<i>d.</i>
2	13	6
10	01	0
96	06	0
8	00	6

first sum, viz. 2*l.* 13*s.* 6*d.* by 3 the 104 06 6 Answ. defect or what is wanting to make up 36 to 39, saying 3 times 6 is 18*d.* &c. and find that 3 times 2*l.* 13*s.* 6*d.* is 8*l.* 0*s.* 6*d.* which added to 96*l.* 6*s.* gives the total, viz. 104*l.* 6*s.* 6*d.* the compleat product by 39; for 36 and 3 make 39. See the work above.

Example 2. What comes 79 C. of Cheese to, at 28*s.* per C.?

<i>l.</i>	<i>s.</i>	<i>d.</i>
1	08	0

7 and 11

9	16	0
1		

107	16	0
2	16	0

110	12	0

In this example I say, 7 times 0 is 0; then 7 times 8 is 56, which is 7 and 11 2*l.* 16*s.* set down 16, and carry 2; then 7 times 1 is 7 and 2 is 9: So the first product is 9*l.* 16*s.* which multiplied by 11, produces 107*l.* 16*s.* or the value of 77; then for 2 wanting, I multiply the price by it, and that gives 2*l.* 16*s.* which added to 107*l.* 16*s.* makes the whole value 110*l.* 12*s.* as in the work.

O 3

Or,

Or, as there are no pence in the price, you may multiply 28s. by 79, without bringing it into pounds, as you work it, but omit it to the last, and then cut off or separate the last figure or cypher of the product towards the right-hand, and halve those towards the left, which will be pounds, and the figure cut off, shillings, as in this example.

s.
28
79

252
196

221 2

The half of 2 is 1, and the half of 2 £. 110 12 is 1; and the half of 10, which 1 joined to the 2 severed from 221, makes 12; for the answer, 110l. 12s. as before. This will be sufficiently explained in Division.

Example 3. 112 pounds of Sugar, at $5d\frac{1}{2}$ per lb. Set it down thus:

d.
$5\frac{1}{2}$ per pound
10 and 10

4 07
0 10

2 05 10
05 06 the product of $5d\frac{1}{2}$ by 12 defective.

2 11 04 the answer.

Here after I have multiplied by 10 and 10 the parts of 100, there wants 12; wherefore I multiply $5d\frac{1}{2}$ by 12, and it gives 5s. 6d. for 12 lb. at $5d\frac{1}{2}$, which added to 2l. 5s. 10d. the value of 100, makes 2l. 11s. 4d. the true value of 112 lb. at $5d\frac{1}{2}$ per pound.

Example

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Example 4. 94 stone of Beef, at 2*d.* or 1*s.* 10*d.* per stone,

s. d.

1 10

10 and 9 Here, what is wanting after the two multiplications is 4; wherefore I multiply 1*s.* 10*d.* (the price) by 4, which produces 7*s.* 4*d.* to be added, &c.

18 4

9

8 05 0

7 4

8 12 4 Answer.

Example 5. 97 C. and a half of Raisins, at 1*l.* 5*s.* 6*d.* per C.

l. s. d.

1 5 6

9 and 10

11 09 6

10

114 15 0

8 18 6

12 9 for the $\frac{1}{2}$ C.

124 06 3 Answer.

After I have multiplied by 9 and 10, I multiply the price 1*l.* 5*s.* 6*d.* by 7, the quantity wanting, and it produces 8*l.* 18*s.* 6*d.* then for the half C. I take half of the price, which is 12*s.* 9*d.* and then collect the three lines, the total of which is 124*l.* 6*s.* 3*d.* for the answer,

Note, From the last example it is evident, that there is no need of being too solicitous to come so very near by two multiplications; for there 7 is wanting to make up the true quantity; nay, if the two multiplications come within 10 or 12, it is near enough; for 'tis as easy to multiply the price by 10 or 12, as by 2 or 3, and the addition is the same.

Example

Example 6. What comes 110 C. $\frac{1}{2}$ of Hops to, at 4*l.* 10*s.* 6*d.* per C.

<i>l.</i>	<i>s.</i>	<i>d.</i>
4	10	6
45	05	00
452	10	00
45	05	00
2	05	03
1	02	07 $\frac{1}{2}$
501	02	10 $\frac{1}{2}$

Answ.

After I have multiplied by 10 and 10, which makes 100; I multiply the price 4*l.* 10*s.* 6*d.* by 10 that is wanting, which gives the same with the first product, *viz.* 45*l.* 5*s.* which stands under the product by 100; and for the $\frac{1}{2}$ of a C. I take $\frac{1}{2}$ of the price, *viz.* first the half, and the half of that half, that is 2*l.* 5*s.* 3*d.* and 1*l.* 2*s.* 7*d.* $\frac{1}{2}$; which four lines added together, make 501*l.* 2*s.* 10*d.* $\frac{1}{2}$ for the answer.

To prove Multiplication.

DIVIDE the Product by the Multiplicand, or Multiplier, and the Quotient will be one of them.

This you cannot do before you have learnt the next rule, *viz.* DIVISION. For the present therefore take this method, *viz.* As you multiplied the multiplicand by the multiplier, so contrarywise multiply the multiplier by the multiplicand; and if the products are alike, the work is right; otherwise one of them is wrong, and must be gone over again till they do agree.

Example 1.

365 Days in a year.
24 Hours in a day.

1460
730

8760 Answ.

Here

Here (reverſely) I ſay, 5 times 4 is 20; 0 and carry 2; 6 times 4 is 24, and 2 is 26; 6 and carry 2; and 3 times 4 is 12, and 2 is 14; ſo that the whole product is 1460. Then 5 times 2 is 10; 0 and carry 1; 6 times 2 is 12, and 1 is 13; 3 and carry 1; and 3 times 2 is 6, and 1 is 7; which makes 730. Which products added together make 8760, the hours in a year, as above, without taking in the odd 6 hours, which the year doth conſiſt of more than 365 days.

Example 2.

36 gallons of Spirits, at 3s. 2d. per gallon.

s. d. I ſay here, twice 7 is 14; 2 and carry 3 2 1s. and 3 times 7 is 21, and 1 is 22s. 7 and 8 or 1l. 2s. Again, twice 8 is 16d. 4 and carry 1s. and twice 8 is 16, and 1 is 17s. 17 and carry 0; and once 8 is 8l. 8 Thus both theſe examples are the ſame in the end, as if you proceeded in the 8 17 4 Anf. common and regular method of multiplication, and ſhews the truth of the operation, which ſhews the work to be right.

The next rule, in order, is DIVISION.

D I V I S I O N.

THE uſe of this rule is to ſhew how many times one number or ſum is contained in another; as if it were aſked, how often is 8 contained in 48? the answer is 6 times; or how many times 12 is there in 60? answer 5 times.

As by Multiplication great denominations are brought into ſmall ones, as pounds into ſhillings, pence, or farthings; ſo by Division, ſmall denominations are brought into greater, as farthings into pence, ſhillings, or pounds. In

In this rule we are to take particular notice of the three following terms.

- 1 } The { Dividend, or number to be divided.
 2 } { Divisor, or number by which we divide.
 3 } { Quotient, or answer to the work; which
 shews how often the Divisor is contained
 in the Dividend.

4. The Remainder; which is an uncertain branch of this rule, because there is sometimes a Remainder, and sometimes not. And you must particularly note, that the Remainder is ever of the same denomination with the Dividend, and is always less than the Divisor; for if it be more, or equal to the Divisor, the work is wrong.

Division is either single or compound; single when the divisor consists of a single figure, and the dividend of two at most: Any question of this kind is answered by the multiplication table; as if 72 were to be divided by 8, the answer will be 9 times. Here 72 is the Dividend, 8 the divisor, and 9 the quotient or answer.

Compound Division is when the dividend hath many, or more figures or cyphers than two, and the divisor one or more figures or cyphers, &c.

Example.

How many times 7 are there in 365? or, how many weeks in a year?

A general rule for working.

- Note { 1. Seek
 2. Multiply
 3. Subtract
 4. Bring down

$$\begin{array}{r} 7 \overline{) 365} \quad (52\frac{1}{2}) \\ \underline{35} \\ 15 \\ \underline{14} \\ (1) \end{array}$$

Having

Having set down the example with two crooked lines, or half parenthesis, one for the divisor, and the other for the quotient, I begin according to the aforementioned general rule for working, by seeking or asking how often I can take 7 the divisor, out of 36, the two first figures of the dividend (for I cannot take 7 out of 3, the quotient being never to begin with a 0) and the answer is 5 times; wherefore I place 5 in the quotient, and multiply the divisor 7 by it (as directed in the general rule,) saying 5 times 7 is 35, which I place under 36; and then thirdly, according to the said rule, I subtract 35 from 36, and there remains 1; to which I bring down the next or last figure of the dividend, viz. 5, and then there is 15 for a new dividend to work upon; then I ask or seek again, how oft 7 may be taken from 15? and the answer is two times; wherefore I put two in the quotient next to the 5; by which 2 I also multiply the divisor 7, saying twice 7 is 14; which I set down under 15, and subtract, and there remains 1 which I place between parentheses thus (1) as it stands in the work; where observe, that 365 is the dividend, 7 the divisor, 52 the quotient, or answer, and 1 the remainder: The quotient declares that 7 is contained in 365, 52 times and 1 over, or remaining; which is placed after the quotient thus $\frac{1}{7}$, and signifies that there is one seventh of a week, or 1 day, more than just 52 weeks in a year, or 365 days; which is easily to be found, by collecting the days of each calendar month, as they stand in the Almanack.

Note, That if there had been more figures or cyphers in the dividend, they must all have been brought down one by one at a time (and never but one at a time) and (after subtraction) set to the remainder; and if there remains 0, you must still bring down but one figure or cypher at a time; and for every figure or 0 so brought down, there must be a figure or 0 placed in the quotient, according to the times you can take the divisor out of the several dividends you make

make by bringing down a figure or cypher at a time out of the dividend, till all be brought down, and the work ended.

For a specimen, let us divide 8060 pounds of tobacco equally amongst 8 men.

8) 8060 (1007 Quotient.

8...

—

60

56

—

(4)

Here I say the eighths in 8 once, which I put in the quotient; then the eighths in 0, 0 times; which I likewise put in the quotient; then the eighths in 6, 0 times again; which is also placed in the quotient, and there remains 6; to which I bring down 0, the last of the dividend, and it makes 60: Lastly, the eighths in 60, 7 times, 7 times 8 is 56, which take from 60, and there remains 4; so that the quotient shews that each person must have 1007 pounds of tobacco for his share in the dividend 8060, and there remains 4 pounds over and above, which makes half a pound more to each man, because 4 the remainder is half of 8 the divisor; and so the work is done, the quotient gives to each man 1007 pounds and an half for his equal share.

Note, That, in the operation, every time you bring down a figure or cypher, you are to make a point under it in the dividend, to signify that such figure or cypher hath been brought down and done with, as may be observed in the foregoing example.

Though this way of working is plain, and easy to be understood, yet as it is somewhat tedious, I shall here shew a quick and expeditious method when the divisor is a single figure; this will appear in the following examples.

	I.	II.	III.
	$\begin{array}{r} 4 \overline{)78906} \end{array}$	$\begin{array}{r} 5 \overline{)34567} \end{array}$	$\begin{array}{r} 6 \overline{)29702} \end{array}$
Quotient	$\begin{array}{r} 19726 \text{ (2)} \\ 4 \end{array}$	$\begin{array}{r} 6913 \text{ (2)} \\ 5 \end{array}$	$\begin{array}{r} 4959 \text{ (2)} \\ 6 \end{array}$
Proof	$\begin{array}{r} 78906 \end{array}$	$\begin{array}{r} 34567 \end{array}$	$\begin{array}{r} 29702 \end{array}$

In the first of these examples I say, the 4's in 7 once and there remains 3, which considered as placed before 8, the next figure in the dividend, makes 38; then the 4's in 38, 9 times 4 is 36, from 38, and there remains 2; which makes 29, the next figure in the dividend, 29; then the 4's in 29, 7 times; 7 times 4 is 28, from 29, and there rests 1; which makes 10, the next of the dividend, 10, and the 4's in 10 twice; twice 4 is 8, from 10, and there remains 2; which makes 26, the last figure of the dividend 26; lastly, the 4's in 26, 6 times, and 6 times 4 is 24, from 26, and there rests 2 the remainder: And so for the other two examples. And for the proof of the work, (or of any other examples) multiply the quotient by the divisor, and take in the remainder in the first place, or place of units; and if the product be the same with the dividend, the divisor is right; for I say 4 times 6 is 24, and 2 the remainder make 26; 6 and carry 2, &c.

More Examples for a single Figure.

	$\begin{array}{r} 3 \overline{)54321} \end{array}$	$\begin{array}{r} 7 \overline{)279060} \end{array}$	$\begin{array}{r} 9 \overline{)234567} \end{array}$
Quotient	$\begin{array}{r} 18107 \text{ (0)} \end{array}$	$\begin{array}{r} 39865 \text{ (5)} \end{array}$	$\begin{array}{r} 26063 \text{ (0)} \end{array}$
Proof	$\begin{array}{r} 54321 \end{array}$	$\begin{array}{r} 279060 \end{array}$	$\begin{array}{r} 234567 \end{array}$

This is the shortest way of Division that can be by a single figure. P As

As it is necessary for expedition to multiply by 11 and 12, as by a single figure, to have the product in one line; so it is likewise necessary to divide by them, as in these examples, viz.

$\begin{array}{r} 11 \overline{) 72646266} \\ \text{Quotient} \quad 6604200 \text{ (6)} \\ \quad \quad \quad 11 \\ \hline \text{Proof} \quad 72646266 \end{array}$	$\begin{array}{r} 12 \overline{) 76677240} \\ \text{Quotient} \quad 6389770 \\ \quad \quad \quad 12 \\ \hline \text{Proof} \quad 76677240 \end{array}$
--	--

$\begin{array}{r} 11 \overline{) 47627000} \\ \text{Quotient} \quad 4329927 \text{ (3)} \\ \quad \quad \quad 11 \\ \hline \text{Proof} \quad 47627000 \end{array}$	$\begin{array}{r} 12 \overline{) 42007400} \\ \text{Quotient} \quad 3500616 \text{ (8)} \\ \quad \quad \quad 12 \\ \hline \text{Proof} \quad 42007400 \end{array}$
--	--

In the first of these examples I say, the 11's in 72, answer 6 times, &c. In the second I say, the 12's in 76, answer 6 times, &c. In the third, the 11's in 47 4 times; 4 times 11 is 44, from 47 and there rests 3, &c. In the fourth I say, the 12's in 42, three times 12 is 36, from 42, and there remains 6, &c.

By being ready and expert in the examples above, you may easily divide by these numbers, viz. 110, 120, 1100, 1200, &c. for it is but cutting off, or separating the cyphers from 11 and 12, (when these numbers happen to be the divisors) and cutting off or separating the like numbers of figures or cyphers from the right hand of the dividend, and then divide the other figures or cyphers towards the left hand, by 11 or 12, as it shall happen; as in the examples following, viz.

Divide

Divide 34567 by 110, and 890123 by 120, and 98765 by 1100, and 678901 by 1200.

$\begin{array}{r} 11,0 \overline{) 34567} \\ \text{Quotient} \quad 314 \frac{2}{11} \text{ or } \frac{3454}{11} \end{array}$	$\begin{array}{r} 12,0 \overline{) 890123} \\ \text{Quotient} \quad 7417 \frac{5}{12} \text{ or } \frac{89005}{12} \end{array}$
$\begin{array}{r} 11,00 \overline{) 98765} \\ \text{Quotient} \quad 89 \frac{6}{11} \text{ or } \frac{9754}{11} \end{array}$	$\begin{array}{r} 12,00 \overline{) 678901} \\ \text{Quotient} \quad 565 \frac{1}{12} \text{ or } \frac{6785}{12} \end{array}$

When you divide by 10, 100, 1000 or 10000, &c. you have nothing more to do than to cut off, or separate as many figures or cyphers of the dividend towards the right-hand, as you have cyphers in the divisor; and those figures towards the left make your quotient, and those cut off towards the right-hand the remainder.

Examples.

Divide 123456789 by 10, 100, 1000, 10000.

By 10 the quotient is 12345678, and the remainder 9.

By 100 the quotient is 1234567, and remainder 89.

By 1000 the quotient is 123456, and remainder 789.

By 10000 the quotient is 12345, and remainder 6789.

When the divisor consists of several figures, the work is attended with a little more difficulty; but if the following directions are carefully observed, the seeming difficulty may be easily overcome; as in the following example,

Suppose I am to divide 78901 pounds among 32 parishes; or suppose an assessment of so much money was laid on so many parishes, what must each parish pay by an equal proportion towards the raising such a supply?

P 2

Divisor

Divisor 32)78901 (... Quotient.

The example thus set down, I begin at the left-hand, seeking how often I can take 32 out of 78; or, more easily, How many times 3 is there in 7, and the answer is two times, which I place in the quotient thus, 32)78901 (2 and then according to the general rule of working, I multiply the divisor 32, by the 2 placed in the quotient, saying, twice 2 is 4, and twice 3 is 6; so there is 64 to be taken out of 78, as it appears in the margin.

$$\begin{array}{r} 32)78901 (2 \\ 64 \\ \hline 14 \end{array}$$

Then I make a point under 9, the third figure of the dividend, and bring it down to the remainder 14, and then the work appears as in the margin.

$$\begin{array}{r} 32)78901 (2 \\ 64 \\ \hline 149 \end{array}$$

Then seek again, asking, how many times 32 in 149, which is not readily to be answer'd; but how many times 3, the first figure in the divisor, is there in 14, the two first figures of the dividend 149, and the answer is 4 times; wherefore, after placing 4 in the quotient, I multiply (as directed in the general rule) the divisor 32 by the said 4, saying, 4 times 2 is 8, placing it under 9 in the dividend; then 4 times 3 is 12, and set it down under 14; so there is 128 to be taken out of 149, and then the work appears as in the margin.

$$\begin{array}{r} 32)78901 (24 \\ 64 \\ \hline 149 \\ 128 \\ \hline 210 \end{array}$$

And after subtraction there remains 21; then I make a point under 0 in the dividend, and bring it down to the right of the remainder 21, and then there is 210 for a new dividend; then (as the general rule directs) I seek again, saying, How many times 32 the divisor, is there in 210 the dividend? or easier, How many times 3 in 21? (for observe well, that whenever you have a place more in the dividend than in the divisor, then always seek how oft you can take the first figure of the divisor out of the two first of the dividend) and the answer is 7 times; but it will not bear 7 times, for 7 times 32 is 224, and you cannot take 224 out of

of 210, or rather, you cannot take 22 out of 21; wherefore try in your mind, before you set down the answer, or figure in the quotient, whether it will go the number of times as is most easily suggested; as here, the question or demand is readily answered, 7 times, and so many times 3 may be taken in 21; but when you come to multiply the whole divisor by the times you place in the quotient, you begin at the right hand and go towards the left, carrying the tens that arise to the next place; which increases the product so, that sometimes the subtraction cannot be made, because the under line is greater than the upper, or that which you should subtract from; wherefore first try in your mind as abovesaid, and since it will not bear 7 times, try if it will go 6 times, saying, 6 times 2 is 12, 2 and carry 1, and 6 times 3 is 18, and 1 is 19, and 19 may be taken out of 21; therefore set down 6 in the quotient next to the 4, and multiply the divisor 32 by it, and the work will stand thus:

Here the divisor 32, multiplied by 6, 32)78901(2465
gives 192 to be taken out of 210, and
the remainder is 18; to which after a
point made under it, I bring down the
1, the last figure in the dividend, and
then there is 181 for a new dividual;
then, according to the rule, I seek
again, (for you are to note, That the
aforesaid general rule for working
must be as often repeated as you bring
down a figure or cypher from the di-
vidend, to make a new dividual; and
also, That for every figure or cypher
brought down, there must likewise be

$$\begin{array}{r}
 64... \\
 \hline
 149 \\
 128 \\
 \hline
 210 \\
 192 \\
 \hline
 181 \\
 160 \\
 \hline
 21 \\
 \hline
 \end{array}$$

a figure or cypher placed in the quotient;) how many times 32 the divisor, may be taken out of 181 the dividual, or how many times 3 is in 18, and the ready answer is 6 times; but on trial, I find it will not go 6 times; wherefore I try a time less by one, viz. 5 times, and find it will bear it; and setting 5 in the quotient

next the 6. I multiply the divisor 32 by it, and it produces 160, which subtracted from 181, the last remainder is 21, and the quotient or answer is 2465, and shews, that 32 is contained in 78901, 2465 times, and 21 over, as per work.

Again; Suppose a Nobleman hath 30,000*l.* per annum, what is his daily income?

If you divide 30,000 by 365 (the days in a year) the quotient will be the answer. Set it down for working thus.

365) 30000 (

First seek how many times 365 can be taken in 300; (an equal number of places with the divisor) answer 0 times; wherefore I go a place further to the right-hand in the dividend, (for 0 must never begin the quotient) and make a point under it, viz. under the last 0 but one (as may be seen in the example) and there being a place more in this pointed out dividuall than in the divisor, I seek how oft the first figure of the divisor, viz. 3, is contained in the two first figures or places of the dividend, viz. 30, and the answer is 10 times; but you are never to take above 9 times at once, in any of these examples of division; wherefore try in your mind whether it will bear 9 times, before you set it down in the quotient (as was said before) saying to yourself or in your mind, 9 times 5 is 45, 5 and go 4; and 9 times 6 is 54, and 4 is 58, 8 and go 5; and 9 times 3 is 27, and 5 is 32; now 32, cannot be taken out of 30, wherefore take a time less by a unit or one, 365)30000 (8
viz. 8 times, and finding it will go 8
times, set 8 in the quotient, and then
say, 8 times 5 is 40, 0 and carry 4; and
8 times 6 is 48, and 4 is 52, 2 and carry
5; and 8 times 3 is 24, and 5 is 29; and then there
is 2920 to be taken from 3000, and there remains 80.
Then to the remainder 80 I bring down 0, the last of
the dividend, and then there is 800 for a new dividu-

dividual; then you must try how oft you can take 365 out of the said dividual 800, and the number of places being equal both in divisor and dividual, to wit, 3, ask, how oft 3 in 8, answer twice; so put 2 in the quotient, and say twice 5 is 10, 0 and carry 1; and and twice 6 is 12, and 1 is 13, 3 and carry 1; and twice 3 is 6, and 1 is 7; so there is 730 to be deducted from 800, and the remainder is 70, as in the whole work may be seen.

Thus by the work, the Nobleman hath 82 pounds *per diem*, and 70 pounds over; which if multiplied by 20 (the shillings in a pound) would produce 1400 shillings; 365)30000 (82 which if divided *per* said divisor 365, there would come out 3s. a day more, and there will be a remainder of 305, which multiplied by 12, (the pence in a shilling) produces 3660, which divided still by 365, gives 10d. a day more. So that 30,000l. a year is 82l. 3s. 10d. a day.

$$\begin{array}{r} 2920 \\ \hline 800 \\ 730 \\ \hline 70 \end{array}$$

Divide 46242 gallons of Canary, by 252 (the gallons in a tun.) Thus set down.

In this example, after enquiry, I find that it will not go twice, therefore I set down 1 in the quotient, and place 252 under 462 of the dividend, and after subtraction, the remainder is 210, to which I bring down 4 from the dividend, and the dividual is 2104; and then seeking again, find it will bear 8 times, which placed in the quotient, and the divisor 252 multiplied by it, the product is 2016 to be subtracted from 2104, which being done, the remainder is 88; to which 2 (the last figure of the dividend) being brought down, there

$$\begin{array}{r} 252)46242 (183 \\ \hline 252 \\ \hline 2104 \\ 2016 \\ \hline 882 \\ 756 \\ \hline 126 \end{array}$$

is 882 for the last dividuall; and then seeking again, I find it will go 3 times, and the product of the divisor multiplied by 3, is 756, which subtracted from 882, there remains 126 for the last, or true remainder. So that by this division I find there are 183 tuns in 46242 gallons, and 126 gallons remaining, or over and above; which being half of 252 the divisor, the remainder is therefore half a tun more.

When you have a cypher or cyphers in the divisor in the first, second, or third place, &c. separate such cypher or cyphers, with a dash of the pen, from the rest of the divisor: and also cut off as many figures or cyphers from the right of the dividend, as you cut off cyphers from the divisor, and divide the remaining figures towards the left-hand, by the remaining significant figures of the divisor.

Divide 42952 square poles of land by 160 the square poles in an acre of land.

Here the cypher is cut off from 16[0]4295|2 (268 the divisor, and 2 from the dividend; then I ask, How oft 16 in 42? Answer, twice, then the 16's in 109, Answer six times; then the 16's in 135, Answer 8 times. So there are 268 acres, and 7 remains; that is, 268 acres $\frac{7}{16}$ or $\frac{70}{160}$, or almost half an acre.

$$\begin{array}{r}
 32 \\
 \hline
 109 \\
 96 \\
 \hline
 135 \\
 128 \\
 \hline
 7
 \end{array}$$

Divide

Divide 6274620 by 2700

27|00)62746120 (2323²⁵²⁰₂₇₀₀

54...

87

81

64

54

106

81

25

In this example two cyphers are separated from the divisor, and also two places from the dividend, and then 62746 is divided only by 27. See the Work.

When the divisor is 3, 4, 5, 6, or more figures, there is a sure and easy way of performing the work truly, by making a table of the divisor; which may be done by addition, or multiplying the divisor by 2, 3, 4, &c.

Suppose you are to divide 987654321 by 123456.

123456)987654321 (8000

987648...

6321

Here having noted the number of figures in the divisor, which here is six, I make a point under the seventh figure, or place of the dividend, &c.

This

1 123456

2 246912

3 370368

4 493824

5 617280

6 740736

7 864192

8 987648

9 1111104

This table is made by doubling the first line, which is 246912, which added to the first or uppermost line gives the third line 370368, which also added to the said first line makes 493824 for the fourth line or product; and so of the rest, still remembering to add the subsequent line, or product to the first or uppermost line, till you come to the last line of 9 times, which is 1111104. The truth of which may be proved by multiplying the first or uppermost line by 2, 3, 4, 5, &c. And if you commit an error by addition, it may be found out or corrected by Multiplication.

When you have pointed out your number of places in the dividend, cast your eye on the table, and at the first view you may know how many times you can take; as in this example, 7 times is too little, and 9 times too much; wherefore I set down 8 in the quotient, and then multiply and subtract, and the remainder is 6; to which I bring down 3, and put 0 in the quotient; then to the 63 I bring down 2, and place another 0 in the quotient; then to 632 I bring down 1, the last figure of the dividend; but still it will not bear any time or times, wherefore I put another 0 in the quotient; and so the work is done, and the quotient is 8000, and the remainder 6321; as in the work.

Thus having plainly, fully, and pertinently shewn by verbal directions, the method of working division, I think it unnecessary to give any more examples in that manner; but shall leave some few examples for practice sake, whose quotients and remainders are expressed, but the operation omitted, to save room, and for trial of the ingenuity of practitioners.

74006-

UNIVERSAL COMPANION. 167

740690042 divided by 987, the quotient is 7498166, and remainder 200.

479679002742 divided by 4689, the quotient is 102298784, and remainder 4566.

796976702 divided by 976294, the quotient is 8163, and remainder 279080.

456789012345 divided by 9876543, the quotient is 46249, and remainder 8775138.

76469747 divided by 4500, the quotient is 16993, and remainder 1249. And,

8092420000 divided by 345000, the quotient is 23456, and remains 0.

The Proof of Multiplication and Division.

THESE two rules reciprocally prove each other; for in proving multiplication, if you divide the product by the multiplier, the quotient will be like the multiplicand; or if by the multiplicand, the quotient will be the same with the multiplier.

Example.

$$\begin{array}{r}
 345 \\
 24 \\
 \hline
 1380 \\
 690 \\
 \hline
 24)8280 \quad (345 \\
 72.. \\
 \hline
 108 \\
 96 \\
 \hline
 120 \\
 120 \\
 \hline
 0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \text{Or thus,} \\
 345)8280 \quad (24 \\
 690 \\
 \hline
 1380 \\
 1380 \\
 \hline
 0 \\
 \hline
 \end{array}$$

To prove Division.

Division may be proved by Division thus:

If you divide the dividend by the quotient, the quotient will be your former divisor.

Example. Divide 8280 by 345

Here the working again is needless, it being above; and shews the truth of the assertion, that division may be proved by division as aforesaid.

But the most usual way of proving division is by multiplication, in this manner, *viz.* Multiply the quotient by the divisor, and the product will be equal to the dividend; as in the foregoing example.

Note. That where there is any remainder, such remainder must be taken in or added to the product.

345 Quotient.
24 Divisor.

1380
690
—
8280

As in multiplication I gave some examples of its utility in money, so likewise I shall give a few examples in Division of money; whereby you may see how expeditiously some things may be done, without having recourse to reduction, the rule of three, &c.

Example 1. Divide 26l. 12s. 6d. equally among 5 men.

For disposition of working set it down as follows:

l. s. d. 5) 26 12 6 — 5 06 6 — 5 — Proof 26 12 6 —	In working of this, I say, the 5's in 26, 5 times; 5 times 5 is 25, from 26 and there remains 1, or 1l. or 20s. which, with the 12s. in the place of shillings makes 32s. then the 5's in 32, 6 times; 6 times 5 is 30, from 32, and there remains 2s. or 24d. which
---	---

which with the 6d. in the place of pence, makes 30; then the 5's in 30, 6 times; and so the work is done; and the answer is, that each man must have 5l. 6s. 6d. for his equal share in the said division of 26l. 12s. 6d. amongst 5 persons; and the truth of it is proved by multiplication of money, sufficiently shewn in the rule of multiplication; as here 5 times 6 is 30, 6 and carry 2; and 5 times 6 is 30 and 2 is 32, 12 and carry 1; and 5 times 5 is 25, and 1 is 26, &c.

Example 2. Divide the charges of a country-feast, amounting to 246l. 13s. 4d. equally amongst 12 Stewards, to know what each Steward must pay.

Here, I say, the 12's in 24, twice, and the 12's in 6, 0 times and there remains 6l. or 120s. and 13s. makes 133; then the 12's in 13 once, and the 12's in 13 once, and there remains 1s. or 12d. then 12 and 4 is 16; the 12's in 16 once, and 4 remains; so that each Steward must pay 20l. 11s. 4d. $\frac{4}{12}$, or four twelfths of a penny, something more than a farthing; and this may be proved as that above.

$$\begin{array}{r} \text{l. s. d.} \\ 12 \overline{) 246 \ 13 \ 4} \\ \underline{ 240 0} \\ 6 13 4 \\ \underline{ 60 12} \\ 1 1 4 4 \\ \underline{ 12 12} \\ 0 2 4 4 \end{array}$$

Answer 20 11 $1\frac{4}{12}$

When any quantity is such a number, that any two digits of the multiplication table, multiplied together, make the said quantity or number, then the quotient may be very expeditiously found at two divisions, and sooner than at one. *Example:* Divide 7872 by 32. In this example, the digits, component parts, or numbers, which multiplied together, make the divisor 32 are 4 and 8, or 8 and 4; for it matters not which of the numbers you divide by first; for both divisions together give a true answer and the same quotient; as may be seen by the different methods in the following work.

Q

$$4 \overline{) 7872}$$

$$\begin{array}{r} 4 \overline{) 7872} \\ \underline{} \end{array}$$

$$\begin{array}{r} 8 \overline{) 1968} \\ \underline{} \end{array}$$

246 quotient

$$\text{Or thus, } \begin{array}{r} 8 \overline{) 7872} \\ \underline{} \end{array}$$

$$\begin{array}{r} 4 \overline{) 984} \\ \underline{} \end{array}$$

246 quotient.

Here, though the operations are different, yet the quotients are the same. Again, divide 44184 by 56.

Example 3.

$$\begin{array}{r} 7 \overline{) 44184} \\ \underline{} \end{array}$$

$$\begin{array}{r} 8 \overline{) 6312} \\ \underline{} \end{array}$$

789 quotient.

Here the divisors are 7 and 8, or 8 and 7; for either, or both, will give the same quotient.

And thus may above forty examples be wrought by numbers out of the multiplication table, with great dispatch and expedition, as by 15, 18, 25, 35, 64, 72, 96, &c.

When it happens that there is any remainder in the first division, or the last, or in both; to know the true remainder, as if you divided by the common way, take this method, *viz.* multiply the first divisor by the last remainder, and take in or add the first remainder, if there be any, and the product will be the true or same remainder as if you divided by the long way.

Example:

UNIVERSAL COMPANION: 170

Example.

Divide 4567 by 15.

Here I multiply 3, the first divisor, by 2, the last remainder, and take in 1, the first remainder, and it makes 7 for the true remainder, as may be proved at leisure, by the other way.

$$\begin{array}{r} 3 \overline{) 4567} \\ \underline{15} \\ 52 \\ \underline{45} \\ 72 \\ \underline{60} \\ 12 \\ \underline{10} \\ 2 \end{array}$$

The same method may be taken with respect to component parts in division of money, as in division of simple numbers.

Example. Divide 463l. 12s. 06d. into 18 equal parts.

$$\begin{array}{r} 3 \overline{) 463 \text{ } 12 \text{ } 06} \\ \underline{12} \\ 154 \text{ } 10 \text{ } 10 \end{array}$$

Ans. 25 15 1 0 $\frac{2}{3}$

By this method of division of money (if the quantity be as aforesaid, made by even component parts) you may, by having the price of several things, know the price or value of one thing, at the said rate, as well as by the rule of three: So doth multiplication of money answer questions in the rule of three, when the first number is a unit or one.

Q 2

Example

Example by Division.

If 84 lb. of Coffee cost 3 l. 10 s. 0 d. what is that a lb?

$$\begin{array}{r} \text{l. s. d.} \\ 7 \overline{) 31 \ 10 \ 0} \end{array}$$

$$\begin{array}{r} 12 \overline{) 4 \ 10 \ 0} \end{array}$$

Ans. 0 07 6 a pound.

As in multiplication of money, to have an answer, you multiply the price by the quantity; so in division of money, you divide the price by the quantity to have your answer.

And this may suffice at present for multiplication and division, the various and excellent uses of which will be better understood in the following rules of arithmetic, particularly in the next rule, called **REDUCTION.**

R E D U C T I O N.

REDUCTION is performed by the foregoing rules of multiplication and division.

For any greater name or denomination is brought into a smaller by multiplication, by multiplying by so many of the smaller as makes one of the greater.

Thus if you multiply pounds in money by 20, the product is shillings: or shillings by 12, the product is pence: or pence by 4, the product is farthings.

On

UNIVERSAL COMPANION. 173

On the contrary, all smaller denominations are brought into greater by division, by dividing the smaller denomination by as many of the smaller as makes one of the greater.

Thus, if you divide any number of farthings by 4, the quotient shews the pence; pence divided by 12, give shillings in the quotient; and shillings divided by 20, give pounds in money in the quotient.

In 520l. how many shillings, pence, and farthings?

$$\begin{array}{r}
 \text{l.} \\
 520 \\
 20 \\
 \hline
 \text{Shillings } 10400 \\
 12 \\
 \hline
 20800 \\
 10400 \\
 \hline
 \text{Pence } 124800 \\
 4 \\
 \hline
 \text{Farthings } 499200
 \end{array}$$

How many shillings, pence, and farthings are there in

$$\begin{array}{r}
 224\text{l. } 15\text{s. } 6\text{d.} \quad \text{l. } \text{s. } \text{d.} \\
 224 \quad 15 \quad 6 \\
 20 \\
 \hline
 4495 \text{ Shillings} \\
 12 \\
 \hline
 8996 \\
 4495 \\
 \hline
 53946 \text{ Pence} \\
 4 \\
 \hline
 215784 \text{ Farths.} \\
 Q3
 \end{array}$$

UNIVERSAL COMPANION. 175

Case 1.] When a number of one denomination is given to be reduced into a lesser denomination.

Rule.] Multiply the given number by so many units of the inferior denomination into which you would have the number reduced, as are contained in an unit of the denomination which is given, and the product is the answer.

Example 1. *In 564 pounds how many farthings?*

564 pounds.
960 farthings in a pound

33840
5076

541440 farthings for answer.

Example 2. *In 87 hundred weight, how many pounds?*

87 hundred.
112 pounds in one hundred.

174
87
87

9744 Pounds for answer.

Example 3. *In 527 Ells Flemish, how many quarters of a yard, each ell being three quarters of a yard.*

527 ells

3 quarters of a yard in an ell *Flemish*.

1531 quarters of a yard for answer.

Example

Example 4. In 328 bales of Dowlas, how many pieces?

328 bales.

3 pieces in a bale.

984 pieces for answer.

Example 5. In 484 gross of tape, each gross 12 dozen, each dozen 2 pieces, and each piece 36 yards, how many yards?

484 gross.

12 dozen in a gross.

968

484

5808 dozens in 484 gross. } Multiply
72 yards in a dozen.

11616

40656

418176 yards for answer.

Case 2.] When it is required to reduce numbers of divers denominations into the lowest denomination.

Rule.] Work as in the last Case; but if you have any number of the next inferior denomination to that you are reducing, add such number to the product.

Example

UNIVERSAL COMPANION. 177

Example 1. *In 364l. 5s. 5d. how many pence?*

l.	s.	d.	
364	5	5	Multiply and add the 5s.
20	the shillings in a pound.		

7285	Shillings in 364l. 5s.	}	Multiply and add the 5d.
12	Pence in a shilling		

14575

7285

87425 Pence in 364l. 5s. 5d. for answer.

In the last example in reducing the pounds, say 4 times 4 in the pounds is 16, but 5 (in the shillings) is 5 shillings; then say, 2 times 4 is 8, &c. And, when you come to the shillings, 2 times 5s. is 10, and 5 in the pence place is 15d. put down 5 and carry 1, &c. *Note,* That if you add any thing in the ten's place, either in the shillings, pence, &c. you must add them when you multiply by the figure in the ten's place of the multiplier.

Example 2. *In 48l. 17s. 11d. 2q. how many farthings?*

l.	s.	d.	q.	
48	17	11	2	Multiply and add the 17s.
				20 the shillings in a pound.

977	Shillings in 48l. 17s.	}	Multiply, adding the 11d.
12	Pence in a shilling,		

1965

977

11735 Pence in 48l. 17s. 11d. } Multiply and add the 2q.

49942 Farthings in 48l. 17s. 11d. 2q. for Ans.

Example

Example 3. In 47 C. 2 qrs. 24 lb. how many pounds?

C. qr. lb.

47 2 24

4 quarters in 112 lb. } Multiply, and

190 quarters in 47 C. 2 qrs. } Multiply, and
28 pounds in 1 Q. of C. } add the 24 lb.

1524

382

5344 pounds is 47 C. 2 qrs. 24 lb. for answer.

This question is more briefly resolved, as in the margin, by first putting down your 47 C. 4 times, and the 2 qrs. 24 lb. which is 80 lb. in tens and units place; so the sum is the answer.

47 C. 2 qrs. 24 lb.

47

470

478

5344 lb. for Answer.

Reduction ASCENDING.

Is, when numbers are reduced from a lesser into a greater denomination.

Case. 1.] When the number given is to be reduced to the next superior denomination.

Rule.] Divide the said given number by such a number of units of the denomination given, as makes an unit of the next superior denomination, and the quotient is the answer.

Example 1. In 984 pieces of Dowlas, how many bales, each 3 pieces? See the operation.

3) 984 (328 Bales for answer.

9

8

6

24

24

0

Example

Example 2. In 9744 pounds, how many hundred weight?

$$\begin{array}{r}
 112 \overline{)9744} \text{ (87 hundred weight for answer,} \\
 \underline{896} \\
 784 \\
 \underline{784} \\
 0
 \end{array}$$

Case 2.] When the number is to be reduced to a denomination higher than the next superior denomination.

Rule.] Divide the given number, as before, by such a number of the units of the denomination given, as makes an unit of the next higher denomination, and note the remainder. Then divide that quotient by so many units of that name or denomination which it is of, as makes an unit of the next higher denomination to the said quotient, &c. noting the remainders, as in the example following.

Example 1. In 87425 pence, how many shillings, and pounds?

$$\begin{array}{r}
 \begin{array}{r}
 d. \\
 12 \overline{)87425} \\
 \underline{84} \\
 34 \\
 \underline{36} \\
 105
 \end{array}
 \qquad
 \begin{array}{r}
 s. \\
 20 \overline{)72815} \\
 \underline{60} \\
 128 \\
 \underline{120} \\
 8
 \end{array}
 \qquad
 \begin{array}{r}
 l. \\
 364
 \end{array}
 \end{array}$$

8 Answ. 364 l. 5 s. 5 d.

05 s. Remains.

5 d. Remains.

Example

Example 2. In 5344 lb. how many quarters and hundreds?

lb.	Q.	C.
28)5344	4)190	(47
28..	16	
254	30	
Rem: lb. 24	2 Quarters remain.	
	Answer 47 C. 2 Q. 24 lb.	

Example 3. In 418175 yards, how many gross of Tape?

Divide the given number by 72, and that quotient by 12, for answer; because 72 yards is 1 dozen, and 12 dozen 1 gross.

Yards.	Dozens.	
72)418175	12)5808	(484 gross for answer.
360..	48	
581	100	
576	48	
o Rem.	o Rem.	

These questions are the converse of those in reduction descending, and may serve for the proof of them; and likewise to shew the learner the nature and effects of the rules.

Reduction Ascending and Descending

Are those questions that are performed by multiplication and division; such as these that follow, and the like.

Example.

UNIVERSAL COMPANION. 181

Example 1. *In 874 Ells Flemish how many ells English?*

Multiply the given number by 3, and divide the product by 5, and the quotient is the answer.

$$\begin{array}{r}
 874 \text{ Ells Flemish.} \\
 3 \text{ Qrs. of a yard in 1 ell. Multiply} \\
 \hline
 5) 2622 \quad 524\frac{2}{3} \text{ Ells for answer.} \\
 \underline{25..} \\
 12 \\
 \hline
 22 \text{ Answ. } 524\frac{4}{6} \text{ or } \frac{2}{3} \\
 2 \text{ rem. which placed over the divisor is } \frac{2}{3}
 \end{array}$$

Or multiply by 6 and divide by 10, which is shorter.

Note, That the remainder is always of the same denomination with the dividend.

Example 2. *In 46C. of cotton wool, how many pounds, and what is the price at 15d. a pound?* *Answ.* 322l.

$ \begin{array}{r} 46C. \\ 46 \\ 46 \\ 46 \\ \hline 5152 \text{ Pounds.} \\ 15 \text{ Pence for 1 pound} \\ \hline 25760 \\ 5152 \\ \hline \end{array} $	$ \begin{array}{r} d. \\ 12) 77280 \\ \underline{72...} \\ 52 \\ \underline{48} \\ 0 \\ \hline \text{Remains } 0 \end{array} $	$ \begin{array}{r} s. \quad l. \\ 20) 644!0 \quad 322 \\ \underline{6..} \\ 4 \\ \underline{4} \\ 0 \\ \hline \text{Remains.} \end{array} $
--	---	--

77280 Pence for answer, which reduce into pounds as before taught, and per margin.

R

More

*More promiscuous Examples of both kinds of Reduction,
one proving the other.*

In 276l. 12s. how many Pence?

20

12)

In 66384d. how many pounds?

5532

12

210)55312

Answ. 66384d. Answ. £. 276 12

In 47964 grains, how many pounds Troy?

24)47964 210(19918

24...

12) 99 18 pw.

239

216

8 lb. 3oz.

— lb. oz. pw. gr.

In 8 3 18 12 how many grs.

236

216

12

Answ. 47964 grains.

204

192

99

20

Grains 12

1998

24

7994

3997

Answ. 47964 and proof.

In

UNIVERSAL COMPANION. 183

In 34 C. $\frac{3}{4}$ of Cotton Wool, how many pounds?

C.	C.
34	112)3892 (34 $\frac{3}{4}$ Proof
34	336
34	
34 84	532
	448
3892	
	84 lb. or $\frac{3}{4}$ of a C.

In 456 C. 3 qrs. 27 lb. of copper how many pounds?
And what it comes to at 21d. per lb.

C.	Or thus,
456	C.
456	456
456	112
456	
511	5472
	456
51183 Pounds at	111
21d. per lb.	
	51183 pounds
51183	
102366	

1074843 Pence; which bring into pounds by division,

or reduction ascending, as before shewn, and
it will amount to 4478/ 10s. 3d.

Bring 4796 Ells Flemish into Ells English

Multiply by 3, and divide by 5; because 3 quarters
make an ell Flemish, and 5 an ell English.

$$\begin{array}{r}
 4796 \\
 \times 3 \\
 \hline
 5)14388 \\
 \hline
 2877\frac{3}{5}
 \end{array}$$

R 2

Reduce

THE YOUNG MAN'S

Reduce 546 Ells English into Yards.

Multiply by 5, and divide by 4, thus :

	456 English ells.	
	5 qrs. 1 E. ell.	<i>In 570 yards how many ells</i>
	<u>4) 2280</u> quarters.	English ?
		570
		4 Qrs. in a yard.
Yards	<u>570</u> Answer	
	English ells.	5) 2280
		456 Anf. and proof.

Bring 130 tuns of Wine into gallons.

4 Hhds. 1 tun.

	520	<i>Or thus,</i>
	63 Gallons 1 Hhd.	252 Gall. 1 Tun.
	<u>1560</u>	130 Tuns.
	3120	<u>7560</u>
		252
Answer	32760 Gallons.	32760

And so on the contrary by Division.

Lasts, Qrs, Bushels, Pecks.

Reduce 42 3 5 2 into Pecks:
10 qrs. 1 last.

Here I multiply by
423 qrs. 10 and take in 3 qrs.
8 bushels 1 qr. and then by 8, and
take in 5 bushels; and
3389 lastly, by 4, and take
4 pecks 1 bush. in 2 pecks.

13558 pecks, in 42 lasts, 3 quarters, 5
bushels, and 2 pecks.

In

In 13558 Pecks, how many Lasts, &c.

$$\begin{array}{r} 4 \overline{) 13558} \end{array}$$

8) 3389-2 pecks taken in.

10) 42|3-5 bushels taken in

Lasts 42—3 quarters taken in

Answer, 42 lasts, 3 quarters, 5 bushels 2 pecks.

Thus, by the two foregoing examples it is seen, that reduction ascending and descending mutually prove each other, as was said before; and is no more than multiplication and division proving one another.

By Reduction also foreign coins or exchanges may be reduced into sterling money; and, on the contrary, sterling money into foreign.

Example. Reduce 246 Venetian Ducats de Banco into sterling money, the exchange at 52d. sterling per ducat, thus:

246

52

492

1230

12) 12792

26) 10616

53⁶/₁₆ 6s. To be paid in London for the
246 ducats drawn in Venice.

R 3

Reduce

Reduce 53l. 6s. sterling into ducats at 52d. sterling per ducat.

$$\begin{array}{r}
 53 \\
 20 \\
 \hline
 1066 \\
 12 \\
 \hline
 52)12792 \text{ (246 Ducats to be paid in Venice} \\
 104 \text{ for the 53l. 6s. drawn in London.} \\
 \hline
 23, \&c. \\
 \hline
 \end{array}$$

To reduce **Flemish** money into **Sterling** money, divide the pence **Flemish** by the par of exchange, viz. 33s. 4d. and the quotient will be the **sterling** money; and what remains multiply by 20, &c.

Example. In 242l. 13s. 4d. Flemish, how many pounds sterling, &c.

$$\begin{array}{r}
 242l. 13s. 4d. \\
 20 \\
 33s. 4d. \text{ Flemish} \text{ ---} \\
 12 \quad 4853 \\
 \hline
 400 \quad 12 \\
 \hline
 4|00)582|40 \\
 \hline
 l. 145 \text{ Sterk.} \\
 \text{Remains } 240 \\
 20 \\
 \hline
 4|00)48'00 \\
 \hline
 \end{array}$$

Answer 145l. 12 Shillings Sterling.

By

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By the work it appears, that 145*l.* 12*s.* sterling, answers, or is equivalent to 242*l.* 13*s.* 4*d.* Flemish, at 33*s.* 4*d.* Flemish per pound sterling.

Thus Flemish money may be reduced to sterling money, though the *par* of exchange be at any other rate of shillings or pence Flemish: But when at the rate as above, *viz.* 33*s.* 4*d.* (the common *par*) then the answer is sooner found by multiplying by 3, and dividing by 5; for 400*d.* Flemish is the same to 240*d.* sterling, (each being a pound) as 3 is to 5; for if you divide 240 by 3, it quotes 80; so 400 divided by 5 quotes the same.

The foregoing *Example* done by the last proposed method.

£. 340 13 4 *Flemish.*

$$\begin{array}{r} 3 \\ \hline 5 \overline{) 722 \ 00 \ 0} \\ \hline \text{£. } 144 \ 08 \ 0 \end{array}$$

Note, French money is reduced to pounds sterling, by bringing it first to pence sterling and then dividing by 12 and by 20.

In 426 French crowns, each 54*d.* $\frac{1}{4}$ Sterling, how many pounds, &c. Sterling?

$$\begin{array}{r} \text{F. C.} \\ 426 \\ 54 \\ \hline 1704 \\ 2130 \\ 106\frac{3}{4} \text{ or } \frac{7}{2}d. \\ \hline 12 \overline{) 23110 \ 10d.} \end{array}$$

And this 20) 1925
1925 divided by ———
20 makes Ans. *l.* 96 5 10 $\frac{1}{2}$ *St.*

In this example, the number of crowns is multiplied by 54*d.* and for that I take the 4th part of 426, which is 106 $\frac{3}{4}$ of a penny, or a halfpenny; which added to the other pence, gives for total 23110*d.* which divided by 12 quotes 1925, and 10*d.* remains; so the answer is 96*l.* 5*s.* 10 $\frac{1}{2}$ sterling: As in the work.

Again,

Again, Bring 1600 pieces of eight Mexico, at $54d. \frac{1}{4}$ sterling, into pounds, &c. sterling.

$$\begin{array}{r}
 1600 \\
 54 \\
 \hline
 6400 \\
 8000 \\
 400 \\
 \hline
 12 \overline{)86800} \\
 \hline
 210 \overline{)72313 \ 4} \\
 \hline
 \text{£. } 361 \ 13 \ 4
 \end{array}$$

Here the 1600 pieces of eight are multiplied by 54, to bring them into pence; and for the $\frac{1}{4}$ I take the $\frac{1}{4}$ of 1600, &c. as in the work. And the Answer is, £. 361 13 4.

This method is of use in reducing the exchanges of Cadiz, Leghorn, and Genoa. Or when the exchange is at so many pence, and eighths of a penny (as often the exchanges run) then multiply the given number to reduce it into pence, by the pence contained in a piece of eight; and also multiply the said given number apart, by the numerator or upper figure of the fraction, and divide by the denominator or under figure of the fraction, and the quotient will be pence; which add to the other pence produced by multiplying the given numbers by the pence contained in one of the pieces for exchange; then divide the total pence by 12, &c.

Example

Example. Bring 296 dollars at 52d. $\frac{1}{2}$ sterling, into pounds, &c. sterling.

296 Dollars.	
52	
592	Dollars.
1480	296
15392	5
185	8)1480
12)15577	185 Pence.
210)12918 1	

Answer $\underline{\underline{\pounds.64\ 18\ 1}}$ Sterling money due for 296 dollars, at 52d. $\frac{1}{2}$ sterling per dollar.

But Ducats, Dollars, Crowns, Millreas, &c. are more expeditiously cast up by the Rules of Practice hereafter to be explained.

And so much for Reduction. The next rule in arithmetic is,

The GOLDEN RULE, or RULE of THREE.

IT is called the GOLDEN RULE from its great use, not only in arithmetic, but in most parts of the mathematics.

It is likewise called the RULE of THREE, because from three numbers given, we find out a fourth, which bears the same proportion to the third number, as the second doth to the first; from whence also it is called the RULE of PROPORTION. And

And of this Proportion there are two sorts: one called Direct; the other, Indirect or Reverse.

Direct Proportion is when the second and third numbers are to be multiplied together, and their product divided by the first.

Indirect or Reverse Proportion, is, when the first and second numbers are to be multiplied together, and their product divided by the third.

In Direct Proportion, the fourth number contains the third, as often as the second contains the first.

But in Indirect Proportion, the greater the third number is, the less is the fourth; and the less the third number is, the greater is the fourth.

The stating the Question.

The chief difficulty that occurs in the Rule of Three, is the right placing the numbers, or stating the question; for when that is done, you have nothing more to do, but to multiply and divide, and the work is finished.

And in order to state the question right, you must remember, that of the three given numbers, two of them are always of one name or denomination, and the other number is ever of the same name with the fourth number or answer required; and must always be the second or middle number: and the number that asks the question, must still possess the third place, and the other number of the same name with the third, must be the first number; for the first and third number; must always be of one name, viz. both money, both weight, both time, or both measure. And though they be of one kind, yet if one of them is altered, by Reduction, from a higher to a lower name, then the other must be reduced to the same name. For you must particularly Note, That if either the first or third numbers consist of several denominations, that is, of pounds and shillings; or pounds, shillings and pence; or of pounds, shillings, pence, and

and farthings; or of tuns, hundreds, quarters, and pounds, &c. then must they be reduced to the lowest name mentioned. And if any one happens to be of divers denominations, and the other but of one name; then the number of one name must be reduced as low, or into the same name with the other. As suppose the first number is brought into farthings, then the third number though but pounds, must be brought into farthings also. Then you are to multiply the second and third numbers together, (when the proportion is direct) and divide the product by the first number, and the quotient thence arising will be the answer to the question, and in the same name with the middle number: And if in a small denomination, it must be brought by Division to the highest name, for the better understanding the answer. You must also *Note*, that if the middle number be of several denominations, it must be brought into the lowest mentioned.

Example 1. *If 8 yards cost 16s. what will 24 yards cost?*

$$\begin{array}{r}
 8 \quad 16 \quad 24 \\
 \quad \quad 16 \\
 \hline
 \quad \quad 144 \\
 \quad \quad 24 \\
 \hline
 8)384 \text{ (48s. or 2l. 8s. answer.} \\
 \quad 32. \\
 \hline
 \quad \quad 64 \\
 \quad \quad 64 \\
 \hline
 \quad \quad 0
 \end{array}$$

Proof

Proof of the foregoing question.

If 24 yards cost 48s. what will 8 yards cost?

$$\begin{array}{r}
 24 \quad 48 \quad 8 \\
 \quad \quad 8 \\
 \hline
 24 \overline{) 384} \text{ (16s. answer.} \\
 \underline{24 } \\
 144 \\
 \underline{144} \\
 0
 \end{array}$$

Example 2. *What is the interest of 75 pounds, at the rate of 8 pounds per cent per annum?*

The numbers when placed according to the above directions, will be stated thus :

$$100 \quad 8 \quad 75$$

In this example there are two numbers that are principal money, and one that is interest; therefore the interest (according to the rule) must stand in the middle, or second place, the principal on which the interest dependeth, viz. 100 (8l. being the interest thereof) must stand in the first place towards the left hand, and the other principal on which the fourth number (which is the number sought) depends, must possess the first place towards the right-hand.

By the foregoing rules, you may with ease and certainty perform any operation in direct proportion, and for your farther information, take the examples following.

Example 3. *If the interest of 100l. for one year be 8l. what is the interest of 75l. for the same time?*

$$\begin{array}{r}
 100 \quad 8 \quad 75 \\
 \quad \quad 8 \\
 \hline
 100 \overline{) 6100} \text{ (6l. for answer.} \\
 \underline{6000} \\
 100
 \end{array}$$

Exam.

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Example 4. If 32 rundlets of Brandy cost 96l. what will 4 rundlets cost at that rate?

Run.	l.	Run.
32	96	4

4

32) 384 (12l. answer.

64

o Remains.

Example 5. If 12 bags of cotton wool cost 184l. what will 17 bags cost?

Bags,	l.	Bags,	l.	s.	d.
12	184	17	260	13	4

Answer.

1288

184

12) 3128 (260l.

72

8 Pounds remain.

20 Shillings multiply.

12) 160 (13 Shillings.

40

4 Shillings remain.

12 Pence multiply.

12) 48 (4 Pence.

o Remains.

S

Note,

Note, That as in the last example, when any thing remains that is reducible to a lower denomination, after it is so reduced, it must be divided continually by the first number.

Case.] When any of the three numbers given happen to be of divers denominations.

Rule.] You may reduce them into the lowest denomination. And if your first number require to be reduced, your third must be reduced likewise into the same denomination as the first; for the first and third number, as I have already said, must be always of one name or denomination.

Example 1. If 17 hogheads of Sugar cost 320l. 12s, what will 5 of those hogheads be worth?

Hhds. l. s. Hhds.

17 320 12 5

6412 Shillings.

5 Hhds,

} Multiply

17)32060

2|0)188|5

l. s. d. q.
(94 5 10 2 ⁶/₁₇)

....

8

150

o Remains.

146

100

15 Shillings remain.

12 Pence in a shilling } Multiply,

30

15

17)180 (10 Pence

10 Pence remain

4 Farthings in a penny

17) 40 (2 Farthings.

6 Farths, remain to be divided 17.

Note,

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Note, That when you have multiplied the second and third numbers together, and divided the product by the first, the quotient is of the same denomination, as the second number is, after you have reduced it (as in the last example) into its lowest denomination given.

Example 2. If 4C. 1qr. 14lb. of Sugar cost 14l. what will 18C. cost?

C.	qr.	lb.	l.	C.
4	1	24	14	18
				112
				36
				18
				18
				2016 lb. of sugar. } Multiply.
				14 l. Sterl. }

500 lb. of sugar.

$$\begin{array}{r} 8064 \\ 2016 \end{array}$$

$$5|00)282|24 \quad (56 \text{ } 8 \text{ } 11 \text{ } 2 \frac{40}{500} \text{ Ans.}$$

$$\begin{array}{r} 32 \end{array}$$

224 Pounds remain } Multi-
20 Shillings in 1l. } ply.

$$5|00)44|80 \text{ (8 Shillings.)}$$

480 Shillings rem. } Multiply
12 Pence in 1s. }

$$\begin{array}{r} 960 \\ 480 \end{array}$$

$$5|00)57|60 \text{ (11 Pence)}$$

$$\begin{array}{r} 50 \\ 7 \end{array}$$

260 Pence rem. } Multiply
4 Farths. in 1d. }

$$5|00)10|40 \text{ (2 Qrs.)}$$

10 40 farthings remain to be
divided by 500. *Note*

Note farther, That as the farthings which remain to be divided by the common divisor (as in the last example) can be reduced into no lower denomination, you may place them over your divisor, as fractions of a farthing, which shall be explained when we come to Vulgar Fractions, &c.

Case.] When the first of the three given numbers is but an unit, the operation is performed by multiplication only.

Example 1. *If I give 15s. for a pound of Tea, what will 250lb. cost me at that rate?*

lb.	s.	lb.
1	15	250
		<u>15</u>
		1250
		<u>250</u>

3750 Shillings answer, or 187l. 10s.

Example 2. *At 14l. 10s. 6d. per bag of Hops, what cost 55 bags?*

Bag	l.	s.	d.	Bags.
1	14	10	6	55
			<u>20</u>	

290 Shillings.

12

3486 Pence

55 the 3d number. } Multiply.

17430

17430

191730 Pence answ. or 798l. 17s. 6d.

Case

Case.] When the third of the three given numbers, is an unit, the operation is performed by division only, if the work need no reduction.

Example 1. *If 40 pieces of broad cloth cost 59*l*. what will 1 piece cost?*

Pieces.	l.	Piece.
40	590	1
	40)590	(14 $\frac{3}{4}$ or 14 <i>l</i> . 15 <i>s</i> .
	4	Answer.
	19	
	30 Pounds remain.	

Example 2. *If 14 hogheads of tobacco, nett weight 9285lb. cost 619*l*. 10*s*. what will 1lb. cost at that rate?*

lb.	l.	s.	lb.	s.	d.	q.
9285	619	10	1	Answer	1	4 0 $\frac{486}{9185}$
	20					
9285	12390 <i>s</i> .	(1 Shilling.				
	3105 Shillings remain.					
	12					
9285	37260 <i>d</i> .	(4 Pence:				
	120 Pence remain.					
	4					
	480 farthings remain to be divided by 9285.					

S 3

Example

Example 3. *If one bushel of oats cost 3s. 6d. what will a Last, or 10 Quarters cost at that rate?*

First reduce the 3s. 6d. into Pence, that is 42d. and the ten quarters, into bushels, that is 80, and set the question thus :

If one bushel cost 42d. what will 80 bushels cost?

$$\begin{array}{r} 80 \\ \hline 3360 \\ \hline \end{array}$$

The first number will neither encrease by multiplication, nor diminish by division; therefore bring the 3360d. into shillings by dividing by 12 as follows:

$$\begin{array}{r} 12 \overline{)3360} \text{ (280 shillings.)} \\ \underline{24} \\ 96 \\ \underline{96} \\ 0 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \overline{)0} \text{ 28 } \overline{)0} \text{ (14l.)} \\ \underline{2} \\ 08 \\ \underline{8} \\ 0 \\ \hline \end{array}$$

For the proof of this, and the like Questions, reduce the answer into pence, to know whether the operation be right, as appears in the work.

$$\begin{array}{r} 14 \text{ l.} \\ 20 \\ \hline 280 \\ 12 \\ \hline 3360 \end{array}$$

Example

Example 4. *If a chaldron of coals (that is 36 bushels) cost 22s. what will 1 bushel cost?*

Reduce the 22s. into pence, by reduction, which makes 264d. which divide by 36 thus:

Now the remainder 12 being the third part of the divisor 36, shews the part of a penny to be $\frac{1}{3}$, so that a bushel at 22s. a chaldron, will cost 7d. and a third part of a penny.

$$\begin{array}{r} 36 \overline{) 264} \quad (7d. \quad 12 \\ \underline{252} \\ 12 \end{array}$$

Example 5. *If I pay 432l. for 525 quarters of malt, what is the price of 1 quarter after that rate?*

Which being properly stated will stand thus:

If 525 quarters cost 432l. what will 1 quarter cost?

In this question you cannot multiply the second number by the third, because the third number is but one.

Therefore, to perform this question with ease, reduce 432l. into farthings; it makes 414720 farthings, divide this by 525, the quarters of malt, and the quotient, or the answer, is 789 furthings; the remainder, after the division is ended, is but the parts of a farthing.

Lastly, The 789 farthings being reduced, are 16s. 5d. $\frac{1}{4}$, therefore, if 525 quarters of malt be sold for 432l. one quarter will cost 16s. 5d. $\frac{1}{4}$ after that rate. Or, which is better, reduce the 432l. into shillings, and it gives 8640, which divide by 525, and the quotient is 16, and the remainder 240; which multiply by 12, the product is 2880; which divide by 525, the quotient is 5 pence, and the remainder 255; that multiplied by 4, the product is 1020, which divided as before gives 1 farthing, and $\frac{2}{3}$ parts of another farthing.

Example

Example 6. *If a grocer buys 5C. $\frac{3}{4}$ weight of Nutmegs, which cost him 163l. 13s. 8d. how may he sell 1lb. weight without gain or loss?*

Reduce the money into pence, it makes 39284d. for the dividend, and 5C. $\frac{3}{4}$ weight into pounds weight, by reduction, makes 644 pounds weight for the divisor; then divide the 39284 by 644, and the quotient gives 61 pence, the price of one pound, viz. 5s. 1d.

Note, That whatever sum of money you desire to gain, add it to the price, and work as above, to know what the price of one pound will be; so will you know what you will get by every single pound.

Example 7. *If 28 quarters of barley cost 30l. 10s. 6d. tell me what 84 quarters come to at that rate?*

If 28 qrs. cost 30l. 10s. 6d. what will 84 qrs. cost?

	20		12
	—	28)615384	(21978 Pence.
Shillings	610	56	—
	12	—	210)18311---6
	—	55	—
	1226	28	£.91 11 6
	610	—	—
	—	273	—
Pence	7326	252	—
	84	—	—
	—	218	—
	29304	196	—
	58608	—	—
	—	224	—
Sum	615384	224	—
	—	—	—
		00	—
		—	—
			84 Quarters

84 Quarters come to 91*l.* 11*s.* 6*d.*

20

831

12

For a proof I reduce the
91*l.* 11*s.* 6*d.* into pence.

3668

1831

21978

Example 8. If 50*l.* 8*s.* be paid for 112 yards, how
much is that for 7 yards?

Note, The 50*l.* 8*s.* being reduced into shillings,
the question will stand thus:

If 112 yards cost 1008*s.* what will 7 yards cost?

7

112)7056. 63*s.* Answer

672

336

336

0

The

The Rule of Three Inverse, or Indirect Proportion:

WHAT *Indirect Proportion* is, has been hinted already.

In *Direct Proportion*, the product of the first and fourth numbers, is equal to the product of the second and third.

But in *Indirect Proportion*, the product of the third and fourth numbers is equal to the product of the first and second.

The method of stating any question in this rule, is the same with that in the *Direct Proportion*.

For the first and third numbers must be of one name, and so reduced, as in that rule; and the number that asks the question must possess the third place; and the middle number will be of the same name with the answer, as it is there.

To know when the question belongs to the Direct, and when to the Reverse Rule.

When the question is stated as above-said, consider whether the answer to the question ought to be more or less than the second number; if more, then the lesser of the two extreme numbers must be your *Divisor*.

But if less, then the greater of the two extreme numbers must be your *Divisor*.

And if the first number of the three is your *Divisor*, then the *Proportion* is *Direct*; but if the last of the three is your *Divisor*, the *Proportion* is *Indirect* or *Reverse*.

Or without regard either to *Direct* or *Reverse*:
 If more is required, the lesser; } is the *Divisor*.
 If less, the greater;

Example

Example. 1.

If 4 men plane 300 deal-boards in 6 days; how many men will plane them in two days?
If 6 days require 4 men, what 2 days? *Ans.* 12 men.

$$\begin{array}{r} \hline 2) \quad 24 \\ \hline 12 \text{ Ans.} \\ \hline \end{array}$$

Example 2.

If a board be 9 Inches broad, how much in length will make a square foot?

In. B. In L.
If 12 ——— 12, what 9 inches broad?

$$\begin{array}{r} \hline 9) \quad 144 \\ \hline \end{array}$$

Answer 16 Inches in length.

In these examples, the first and second numbers are multiplied together, and the product is divided by the third; for, in the first example, it is most certain, that 2 days will require more hands to perform the work than 6 days; therefore the lesser of the extreme numbers is the *Divisor*; and declares the question to be in the *Indirect Proportion*.

Likewise, in the second example, 9 inches in breadth, must needs require more in length to make a foot, than 12 inches in breadth; wherefore it is in the same *Proportion* with the first example, because the *Divisor* is the third number.

Example

Example 3.

How many yards of silk, of 3 qrs. wide, will line 9 yards of cloth, of 8 qrs. wide?

Qrs. wide. yds. long. qrs. wide.

If 8 ———— 9 what ———— 3
8 Here the

Here the narrower the filk,
the more in length is required.

3) 72

Yards 24 Answer.

Example 4.

If a quartern loaf weigh 5 lb. when wheat is 6s. the bushel, what must it weigh when wheat is 4s. the bushel?

If $\overset{s.}{6} \overset{lb.}{\text{---}} \overset{s.}{5} \overset{lb.}{\underset{6}{\text{---}}} \overset{s.}{4}$ Answer $7\frac{3}{4}$ or $\frac{15}{2}$

$$4)30 \quad (7\frac{2}{4})$$

28

3

Example 5.

If in 12 months 100% principal, gain 5% interest, what principal will gain the same interest in 4 months?

$$\frac{12}{12} \times 100 = 100 \text{ Answer } 300\%$$

12

4) 1200 (300% principal.

12

The

The Double Rule of Three Direct.

In this rule there are five numbers given to find out a sixth, which sixth must bear the same proportion to the product of the fourth and fifth numbers, as the third does to the product of the first and second numbers.

The Rule for stating the five Numbers given is,

Make that the third number from the left hand, which is of the same denomination with the number sought; then place the two numbers in the first and second place to the left hand, which are conjunctive in the sense of the question to the third, and the other two numbers in such order, that the fourth may be of the same denomination with the first, and the fifth of the same with the second: Which done,

Rule.] Divide the product of the three next the right hand, multiplied one in another, by the product of the two next the left hand, and the quotient is the sixth number sought for.

Example. If 100l. in 12 months gain 6l. interest, what will 500l. gain in 8 months?

L. H	Months.	L. I.	L. P.	Months.
100	12	6	500	8
12			6	
Divisor 1200			3000	
			8	
			24	
			00	
			Remains.	

12|00)240|00(20l. Answ:

24

00 Remains.

T

B

By the work you may perceive that 500*l.* will gain 20*l.* in 8 months, at the rate of 100*l.* Principal gaining 6*l.* interest in 12 months.

This question, or any other of the same nature, may be resolved by two operations, in the Single Rule of Three Direct, thus:

*If 100*l.* produce 6*l.* what will 500*l.* produce? The answer is 30*l.**

*Then say, If 12 months require 30*l.* what will 8 months require? The answer, as before, is 20*l.**

The Double Rule of Three Inverse.

The Rule for stating your Question.

Place the three first numbers toward the left hand, in the same order you did in the last rule: And for the other two, place that the fourth, which is of the same denomination with your second number, and consequently the other next the right hand: So will your first and last, *viz.* that required, be of one denomination, your second and fourth of another, and your third and fifth of another: And,

The Rule for performing the Operation is,

Divide the product of the first, multiplied into the second, and that product into the fifth, by the product made of the third and fourth, and the quotient is the answer.

*Example. What principal will raise 20*l.* in 8 months, at 6 per cent. per annum.*

<i>L. P.</i>	<i>Months.</i>	<i>L. I.</i>	<i>Months.</i>	<i>L. I.</i>
100	12	6	8	20
12		8		
1200		48 your divisor.		
20				

L. In.

48)24000 (500 quotient for answer; which proves the last operation.

0 Remains.

Before

Before we leave the Rule of Three, it may be proper to observe, that when four numbers are in such proportion to one another, that the first is to the second as the third is to the fourth, they will continue to hold the same proportion, even when their order is changed a variety of ways, by what is usually called *Alternation*. Here follows an Example,

$$\begin{array}{l}
 2 : 4 :: 6 : 12 \\
 2 : 6 :: 4 : 12 \\
 4 : 2 :: 12 : 6 \\
 12 : 6 :: 4 : 2 \\
 6 : 2 :: 12 : 4 \\
 4 : 12 :: 2 : 6 \\
 12 : 4 :: 6 : 2 \\
 6 : 12 :: 2 : 4 \\
 2 \times 4 : 4 :: 6 \times 12 : 12 \\
 2 \times 6 : 6 :: 4 \times 12 : 12 \\
 4 \times 2 : 2 :: 12 \times 6 : 6 \\
 12 \times 6 : 6 :: 4 \times 2 : 2 \\
 6 \times 2 : 2 :: 12 \times 4 : 4 \\
 4 \times 12 : 12 :: 2 \times 6 : 6 \\
 12 \times 4 : 4 :: 6 \times 2 : 2 \\
 6 \times 12 : 12 :: 2 \times 4 : 4 \\
 4 - 2 : 4 :: 12 - 6 : 12 \\
 6 - 2 : 6 :: 12 - 4 : 12 \\
 12 - 4 : 12 :: 6 - 2 : 4 \\
 12 - 6 : 12 :: 4 - 2 : 6
 \end{array}$$

× That is, *Plus*, or added to.

— That is, *Minus*, or subtracted from.

Thus we see, that these numbers, in all the various forms in which they are here placed, still retain the same proportion to one another: that is, the product of the two extreme numbers is equal to the product of the two mean numbers; in other words, the first and last numbers multiplied into each other, produces the same sum, as the second and third number multiplied into each other.

Arithmetical PROGRESSION.

IS when a rank or series of numbers differ orderly from one another, by some common number.

To find the sum of any Arithmetical progression, add the first and last numbers together, and multiply that sum by half the number of places, and that product is the sum. But if the number of places be odd, multiply the said number of places by half of the first, and last added, and that product is the sum.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

What the sum?

16 Last.

1 First.

17 Sum.

8 Half of the number of places.

136 Sum of the whole.

Suppose a man hires a room for a year, and agrees to pay the first week 5d. the second week 9d. and for the third week 13d. so paying every week 4d. more, until 52 weeks, or a year is finished, I demand what the rent will come to?

Answer 23l. 3s. 8d.

Here you are to consider, that the common increasing number is 4d. so that the last week must amount to 51 times 4, added to the pay of the first week, which is 5d. then will the last week come to 209 pence; then work as in the example.

	51		12)5564 (453s.
	4		48
Product	<u>204</u>		<u>76</u>
	5		<u>72</u>
Added	209 the last week.		44
	5 the first week.		<u>36</u>
Added	214		8d.
	26 Half the weeks in the		
	<u>year,</u>		
	1284		2 0)46 3 (23l. 3s. 8d.
	<u>428</u>		
Pence	<u>5564</u>		

Geometrical Progression

IS when a series of numbers increases in such a manner, that every succeeding number is double of that which precedes it.

Suppose one sold 12 ells of cloth, to receive for the first ell 1d. for the second 2d. the third 4d. and so doubling, what is paid for the 12 ells?

0, 1, 2, 3, 4, 5, 6.
1, 2, 4, 8, 16, 32, 64

32
128
192
2048
2

Answer 4096 Pence.

T 3

Notes

Note, That if this question had been for a farthing a button, or the like, the answer would have been farthings.

Suppose one sold a horse having 4 shoes, and in every shoe 6 nails, to receive for the first nail 1 farthing, the second nail 2 farthings, the third nail a penny, and so doubling, how much is paid for the last nail, and the price of the horse? Answer 17476l. 5s.

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,
1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096
4096

12288

18432

81920

8388608

2

Farthings 16777216

Or if this question had been of a coat sold at a barley-corn a button, and so doubling to 24 buttons, (accounting 900 corns to a pint) I divide the 16777216 by the 900 corns, the quotient gives about 11641 pints, which divide by 64, the pints in a bushel, the quotient gives about 292 bushels, or about 36 quarters of barley for the coat.

The Rule of FELLOWSHIP or COMPANY,

MAY be fitly divided into *Gain, Loss, and Time.*

A General Rule.

*As general stock to general profit bears,
So each man's stock in general profit shares.*

That is to say,

Every man's particular stock being added together, the total must be the first number in the rule of three; the gain is the second, and every man's particular stock the third; as,

Suppose two merchants in company, A. laid in 20l. B. laid in 40l. whereby was gained 50l. what is each man's part of the gain?

$\begin{array}{r} \hline A. \ 20 \\ B. \ 40 \\ \hline 60 \end{array}$	}	If 60l. gain 50l. what will 20l. gain?
		$\begin{array}{r} 20 \\ \hline 6 \overline{) 100} 0 \end{array} \quad (16l. \ 13s. \ 4d.$
		$\begin{array}{r} 6 \\ \hline 40 \\ 36 \\ \hline 4 \end{array}$

If 60l. gain 50l. what will 40l. gain?

$\begin{array}{r} 40 \\ \hline 6 \overline{) 200} 0 \end{array}$	(33l. 6s. 8d.															
$\begin{array}{r} 18 \\ \hline 20 \\ 18 \\ \hline 2 \end{array}$	<table style="border-collapse: collapse;"> <tr> <td style="text-align: right; padding-right: 5px;">l.</td> <td style="text-align: right; padding-right: 5px;">s.</td> <td style="text-align: right;">d.</td> </tr> <tr> <td></td> <td style="text-align: right;">33</td> <td style="text-align: right;">06 8</td> </tr> <tr> <td></td> <td style="text-align: right;">16</td> <td style="text-align: right;">13 4</td> </tr> <tr> <td></td> <td style="text-align: right;">Proof</td> <td style="text-align: right;">50 00 0</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;"><i>Suppose</i></td> </tr> </table>	l.	s.	d.		33	06 8		16	13 4		Proof	50 00 0			<i>Suppose</i>
l.	s.	d.														
	33	06 8														
	16	13 4														
	Proof	50 00 0														
		<i>Suppose</i>														

Suppose two merchants made a stock, A. laid in 45l. and B. laid in 68l. whereby was gained 32l. how must the gains be divided?

If 113l. gain 32l. what will 45l. gain?

$$\begin{array}{r} A. 45 \\ B. 68 \\ \hline 113 \end{array} \quad \left. \vphantom{\begin{array}{r} A. 45 \\ B. 68 \\ \hline 113 \end{array}} \right\} \quad \begin{array}{r} 45 \\ \hline 160 \\ 128 \\ \hline \end{array}$$

113)1440 (12l. $\frac{24}{113}$ A's part

$$\begin{array}{r} 113 \\ \hline 310 \\ 226 \\ \hline 84 \\ \hline \end{array}$$

If 113l. gain 32l. what will 68l. gain?

$$\begin{array}{r} 68 \\ \hline 256 \\ 192 \\ \hline \end{array}$$

113)2176 (19l. $\frac{29}{113}$ B's part.

$$\begin{array}{r} 113 \\ \hline 1046 \\ 1017 \\ \hline 29 \\ \hline \end{array}$$

The 29 of the fraction multiplied by 240, (the pence in 20s.) and the product divided by 113, the quotient tells the pence.

Suppose

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Suppose three merchants, A. B. and C. join their monies to make a stock of 25000l. of which A. laid in 10000l. B. 8000l. C. 7000l. with this (after a certain time of trading) they gained 7500l. how must this be parted?

If 250000l. gain 7500l. what will 10000l. gain?

$$\begin{array}{r}
 10000 \\
 \hline
 25 \overline{) 75000} \overline{) 000} \quad (3000l. \text{ A's part.} \\
 \underline{75} \\
 00000
 \end{array}$$

If 250000l. gain 7500l. what will 8000l. gain?

$$\begin{array}{r}
 8000 \\
 \hline
 25 \overline{) 60000} \overline{) 000} \quad (2400l. \text{ B's part.} \\
 \underline{50} \\
 100 \\
 \underline{100} \\
 0
 \end{array}$$

If 250000l. gain 7500l. what will 7000l. gain?

$$\begin{array}{r}
 7000 \\
 \hline
 25 \overline{) 52500} \overline{) 000} \quad (2100l. \text{ C's part.} \\
 \underline{50} \\
 25 \\
 \underline{25} \\
 0
 \end{array}$$

$\left. \begin{array}{l} A. 3000l. \\ B. 2400l. \\ C. 2100l. \end{array} \right\}$

Stocks added.

$$\begin{array}{r}
 \hline
 7500
 \end{array}$$

Rule

*Rule of FELLOWSHIP with Time.**THE RULE,*

EVERY man's stock must be multiplied by his time, and the total of those products, added together is the first number, the gain or loss the second number, and the product of every man's particular stock and time the third number.

Suppose two merchants in company, A. laid in 100l. for 4 months; B. put in 136l. for 3 months, and they gained 50l. what is each man's part?

$$\begin{array}{l} A. \text{ put in } 100l. \\ B. \text{ put in } 136l. \end{array} \left. \vphantom{\begin{array}{l} A. \text{ put in } 100l. \\ B. \text{ put in } 136l. \end{array}} \right\} \text{Multiplied by } \left\{ \begin{array}{l} 4 \\ 3 \end{array} \right\} \text{ give } \left\{ \begin{array}{l} 400 \\ 408 \\ \hline 808 \end{array} \right.$$

If 808l. gain 50l. what will 400l. gain?

$$\begin{array}{r} 400 \\ \hline 808 \overline{) 20000} \quad 24l. \frac{608}{808} A's \text{ part.} \\ 1616 \\ \hline 3840 \\ 3232 \\ \hline 608 \end{array}$$

If 808l. gain 50l. what will 408l. gain?

$$\begin{array}{r} 408 \\ \hline 400 \\ 2000 \\ \hline 808 \overline{(204000)} \quad (25l. \frac{208}{808} B's \text{ part.} \\ 1616 \\ \hline 4240 \\ 4040 \\ \hline 200 \end{array}$$

Suppose

Suppose three butchers, as A. B. and C. held a pasture, for which they pay 45*l.* per annum, A. hath 24 oxen 32 days, B. hath 12 there 48 days, and C. 16 oxen there 24 days, what must every man pay of the rent?

Oxen.		Days.	
A. 24	} Multiplied by	32	} give
B. 12		48	
C. 16		24	
			768
			576
			384
			1728

If 1728*l.* give 45*l.* what will 768*l.* give?

1728)34560 (20 <i>l.</i>	45
3456	3840
00	3072
	34560

A. pays 20*l.* of the rent.

B. pays 15*l.* C. 10*l.* which makes 45*l.*

OF FRACTIONS.

Notation and Numeration of Vulgar Fractions.

A FRACTION is one or more parts of an Unit or Integer, according as the same is divided.

Every Fraction consists of two parts, viz. a Numerator and a Denominator.

The Denominator, placed below the short line that divides it and the Numerator, shews how many parts the integer or unit is divided into

The Numerator, placed above the short line, shews how many of the said parts, expressed by the Denominator, are contained in the Fraction. For instance:

3 Numerator.
4 Denominator.

In

In reading fractions, the numerator is first mentioned, then the denominator; as the fraction above is read, three fourth parts of any thing; *i. e.* the denominator shews, that the integer is divided into four parts; and the numerator, that three of those four parts are contained in the fraction. So by the same reason,

$\frac{1}{4}$ is one fourth,
 $\frac{2}{4}$ is one half,
 $\frac{2}{3}$ is two thirds,
 $\frac{5}{6}$ is five sixths,
 $\frac{6}{7}$ is six sevenths,
 $\frac{7}{8}$ is seven eighths,
 $\frac{8}{9}$ is eight ninths,
 $\frac{9}{10}$ is nine tenths, &c.

Fractions are either proper or improper.

A fraction, properly so called, or a proper fraction, is when the numerator is less than the denominator, as the fractions foregoing.

An improper fraction is, when the numerator is greater than the denominator, $\frac{7}{4}$, $\frac{23}{20}$, &c. Again,

Fractions are either simple or compound.

A simple fraction is, when the fraction is immediately the fraction of an unit or integer; as those above-mentioned.

A compound fraction is a fraction of a fraction, as $\frac{1}{2}$ of $\frac{1}{4}$ of a pound sterling, which is equal to 2s. 6d. Or it is when an unit is divided into a number of parts, and each of those parts again subdivided into other parts.

Reduction

Reduction of Vulgar Fractions.

It may seem strange to some that reduction is here taught before addition, &c. but it is necessary it should be so, because reduction is made use of in all the subsequent rules, to fit and prepare fractions for addition, Subtraction, &c.

Case 1.] When a mixt number is given to be reduced to an improper fraction.

Rule.] Multiply the integers by the denominator of the fraction, and to the product add the numerator, and place the sum over the denominator for a new fraction.

Example. Reduce $12\frac{3}{4}$ to an improper fraction.

See the marginal operation.

Answer $\frac{51}{4}$

Case 2.] When an improper fraction is given to be reduced to a whole or mixt number.

Rule.] Divide the numerator of the fraction by the denominator, and the quotient is a whole number; and if any thing remains, it must be placed over the divisor.

Example. Reduce $\frac{51}{4}$ to a whole or mixt number:

4)51 ($12\frac{3}{4}$ Answer, which proves the last case:

$$\begin{array}{r} 4 \\ \hline 11 \\ \hline 3 \text{ Remains} \\ \hline \end{array}$$

U

Case

Case 3.] When fractions have different denominators, and are to be reduced to a common denominator.

Rule.] Multiply the numerator of each fraction singly, into all the denominators except its own, and the product is a new numerator; and then multiply all the denominators one into another, and the product is a common denominator.

Example. Reduce $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{1}{5}$ to a common Denominator.

<i>First,</i>	<i>Thirdly,</i>
2 First numerator.	5 Numerator of the 3d.
4 Second denominator	4 Denominator of the 2d.
8 Product.	20 Product.
7 Third Denom. } mult.	3 Denominator of the 1st.
56 First new numerator.	60 Third new numerator.

<i>Secondly,</i>	<i>Lastly,</i>
3 Numerator of the 2d.	3 } Multiply
4 Denominator of the 1st.	4 } Denomi-
12 Product.	12 } Multi- nators.
7 Denominator of the 3d.	7 }
63 Second new numerator.	84 Common denominator.

Now if you place each new numerator over the common denominator, you will have

$\begin{array}{r} 56 \\ 60 \\ 63 \\ 60 \\ 84 \\ \hline 34 \end{array}$	$\left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} \text{Equivalent to}$	$\left\{ \begin{array}{l} \frac{2}{3} \text{ The first fraction given.} \\ \frac{3}{4} \text{ The second fraction.} \\ \frac{1}{5} \text{ The third fraction.} \end{array} \right.$
--	---	---

Case

Case 4.] To reduce a fraction to its lowest terms.

Rule.] Take $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$, &c. of the numerator and denominator.

Example. Reduce $\frac{56}{84}$ to its lowest terms.

Say, half of 56 is 28, and $\frac{1}{2}$ of 84 is 42; the $\frac{1}{2}$ of 28 is 14, and $\frac{1}{2}$ of 42 is 21; and because you cannot take half, $\frac{1}{3}$ make trial if you can take $\frac{1}{3}$, &c. but since you can only take $\frac{1}{7}$ of both, say, the 7's in 14 is 2, and the 7's in 21 is 3, so is the given fraction equivalent to $\frac{2}{3}$, and proves the first fraction in the last case to be right.

$\frac{56}{84}$	or	$\frac{28}{42}$	or	$\frac{14}{21}$	or	$\frac{2}{3}$
Take		Take		Take		Lowest Term.
$\frac{1}{7}$		$\frac{1}{7}$		$\frac{1}{7}$		

Case 5.] To reduce a compound fraction to a simple one, equivalent to the compound.

Rule.] Multiply all the numerators one into another, for the numerator of the answer, and the denominators one into another for that of the answer.

Example. Reduce $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$ into a simple fraction.

The product of the denominators, 4, 12, and 20, is 960, and the product of 1, 1, and one is 1; so the simple fraction sought for is $\frac{1}{960}$.

Case 6.] To find the value of any fraction, whether the same be of coin, measure, weight, &c.

Rule.] Multiply the numerator of the fraction by such a number of units of the next inferior denomination, as is equal to an unit of the denomination the fraction is part of, and divide the product by the Denominator, so the quotient will answer your question; but if any thing remain, reduce that to the next lower denomination and divide as before.

U 2

Example.

Example. *What is the value of $\frac{33}{146}$ of a hundred weight?* See the operation.

134 Hundred. }
4 Quarters in a Hundred. } Multiply

146)536 (3 Quarters of a Hundred.
438

98 Quarters remain. }
28 Pounds in a Quarter. } Multiply

784
196

146)2744 (18 Pounds
146

1284
1168

116 Pounds remain. }
16 Ounces in a Pound. } Multiply

696
116

146)1856 (12 Ounces:

146
396
292

104 Ounces remain. }
16 Drains in an Ounce. } Multiply

624
104

146)1664 (11 Drains $\frac{58}{146}$

146
206
146
58

Q. lb. oz. dr.
Answer 3 18 16 11 $\frac{58}{146}$

Cafe

Case 7.] To reduce fractions of a lower denomination to those of a higher.

Rule.] Consider what denomination your fraction is of, and how many of that make a unit of the next, &c. to the denomination you would have your fraction reduced to; then work as in the sixth case of this chapter.

Example. Reduce $\frac{1}{2}$ of an ounce Aveirdupois to the fraction of an hundred weight.

Case 8.] When you would reduce a fraction of a higher to a fraction of a lower denomination;

Rule.] Reduce the numerator of the fraction into that denomination you would have your fraction of, and place it over the denominator given for a new fraction.

Example. Reduce $\frac{1}{8908}$ of a hundred weight to a fraction of an Ounce.

112 Pounds.

16 Ounces in a pound.

} Multiply

672

112

Product 1792 Ounces in the Numerator: So the

Answer is $\frac{1792}{8908}$; which fraction in its lowest term is $\frac{1}{3}$, and proves the last case. See the work.

$\frac{1792}{8908}$	$\frac{896}{4454}$	$\frac{448}{2227}$	$\frac{112}{556.75}$	$\frac{56}{280}$	$\frac{8}{40}$	$\frac{1}{5}$
Take $\frac{1}{5}$	Take $\frac{1}{5}$	Take $\frac{1}{5}$	Take $\frac{1}{5}$	Take $\frac{1}{5}$	Take $\frac{1}{5}$	

Proof, or more brief by dividing the first by 1792.

U 3

Addition

*Addition of Vulgar Fractions.***CASE I.**

WHEN a simple fraction is to be added to a simple fraction.

RULE.

If the fractions to be added have a common denominator, add the numerators together for a numerator, and place it over the common denominator.

E X A M P L E.

Add $\frac{2}{3}$ and $\frac{4}{9}$ of a pound sterling together. Say, 2 and 3 is 5, and 4 is 9, the numerator; which place over 5 the common denominator, thus $\frac{2}{5}$; and this improper fraction $\frac{2}{5}$, is in value of 36s. for 5/9 9 times 4s. (the 5th of a pound) is 36s. for if the numerator 9, be divided by the denominator 5, *i. e.* $1\frac{4}{5}$ I say the 5's in 9, once, and 4 remains, which is $\frac{4}{5}$ of a pound, or 16s.

But if the fractions to be added have not a common denominator, they must be reduced to one, by the third rule above-mentioned, before addition can be performed; and then proceed as above.

Case 2.] When a mixed number is to be added to a mixed.

Rule.] Work with the fractional parts as before, and afterwards add the sum of the fractions to the sum of the integers, and you have your desire.

Example.

Example. To $1\frac{1}{2}$ add $74\frac{1}{2}$.

The sum of the fractions by the last case is, $1\frac{1}{2}$, which added to 1 and 74 make $76\frac{1}{2}$.

$76\frac{1}{2}$

$1\frac{1}{2}$ } Add
1

74

$76\frac{1}{2}$ the sum required.

Or you may perform the work, by reducing the given numbers to improper fractions; and so proceeding as formerly directed.

Case 3.] When a compound fraction is to be added to a simple one.

Rule.] Reduce the compound fraction to a simple one by your former directions; then find out the sum.

Example. To $\frac{13}{42}$ add $\frac{1}{2}$ of $\frac{2}{3}$.

The compound fractions reduced to a simple one is, $\frac{6}{42}$ or $\frac{1}{7}$.

The common denominator of $\frac{1}{42}$ and $\frac{13}{42}$, is as follows, $\frac{42}{108}$ and $\frac{60}{108}$.

The sum of the numerators is 102, so that $\frac{102}{108}$ is the Answer.

Subtraction

Subtraction of Vulgar Fractions.

Case 1.] When a simple fraction is to be deducted from a simple one.

Rule.] Reduce the fractions to a common denominator as before; then take the numerator of the subtrahend from the other, and place the remainder over the common denominator, and you have the difference sought.

Example. From $\frac{1}{2}$ take $\frac{1}{3}$. See the work.

36 the first numerator. 48 the common denominator
20 the second numerator.

16 difference.

Answer $\frac{16}{48}$ or $\frac{1}{3}$.

Case 2.] When a compound fraction is to be deducted from a simple fraction.

Rule.] Reduce the compound fraction to a simple one, and then work as in the last case.

Example. From $\frac{1}{2}$ take $\frac{2}{3}$ of $\frac{1}{4}$.

The compound fraction reduced to a simple one is $\frac{16}{27}$.

13	16	27
27	14	14
91	64	108
26	16	27

351 the 1st num. 224 the 2d num. 378 the com. D.
224 deduct.

So the Answer is $\frac{127}{378}$.

127 remains.

Case

Case 3.] When a simple fraction is to be deducted from a whole number.

Rule.] Deduct the numerator from the denominator, and place the remainder over the denominator; then deduct 1 from the integer, and place the remainder before the remaining fraction, and you have your answer.

Example. From 12 take $\frac{1}{2}$. The answer is $11\frac{1}{2}$.

Note, That the 1 borrowed from the 12 (in the first method) is $\frac{2}{2}$; so that if from $\frac{2}{2}$ you take $\frac{1}{2}$, there remains $\frac{1}{2}$.

Multiplication of Vulgar Fractions.

Case 1.] When you are to multiply a simple fraction by a simple one.

Rule.] Multiply all the numerators one in another, for the numerator of the product, and likewise the denominators for the denominator of the product.

Example. Multiply $\frac{1}{2}$ by $\frac{2}{3}$. Answer $\frac{2}{6}$ or $\frac{1}{3}$.

Note. The effect of multiplication of fractions is different from that of whole numbers; for the product is always less than the multiplicand, though it is always greater in whole numbers; the former being the multiplying of the parts into which an unit is divided, which must needs make the parts produced less than those given; the latter multiplying units, must needs augment the number; the former diminishing the parts of an unit to infinite littleness; the latter augmenting the number of units *ad infinitum*.

Case

Case 2.] When you multiply a whole number by a fraction.

Rule.] Multiply the integer by the numerator of the fraction, and the product placed over the denominator is the answer; which differs nothing from the last case, if you put an unit under the integral part, making it like a fraction.

Example. Multiply 126 by $\frac{3}{7}$. *Answ.* 54^3 or 54.

Case 3.] When you multiply a simple by a compound fraction.

Rule.] Reduce the compound fraction into a simple one, and work as in the last case but one.

Example. Multiply $\frac{2}{3}$ by $\frac{3}{5}$ of $\frac{7}{7}$.

Answer $\frac{2}{5}$ or $\frac{2}{5}$.

Division of Vulgar Fractions.

Case 1.] When you would divide a simple fraction by a simple one.

Rule.] Having placed the dividend and the divisor, as in the whole numbers, multiply the numerator of the divisor, into the denominator of the dividend, for the denominator of the Quotient: And the denominator of the divisor, into the numerator of the dividend, for the numerator of the quotient.

Example. Divide $\frac{2}{3}$ by $\frac{1}{2}$. $(\frac{2}{3} \div \frac{1}{2} = \frac{4}{3} \text{ or } 1 \frac{1}{3})$

Note, 1. To make a fraction greater in value, is nothing but to multiply, or add, to it's numerator, or to divide or take from it's denominator.

2. To make a fraction less, is to multiply, or add to, it's denominator, or to divide, or take from it's numerator.

Case

Case 2.] When you divide a whole number by a fraction.

Rule.] Place an unit under the whole numbers, and work as in the last.

Example. Divide 54 by $\frac{3}{7}$. See the operation.
 $\frac{3}{7}) 54$ Answer, or 126.

Case 3.] When you divide a simple fraction by a compound fraction.

Rule.] Reduce the compound to a simple fraction, and work as in the last case but one.

Example. Divide $\frac{3}{4}$ by $\frac{5}{8}$ of $\frac{3}{7}$. The compound fraction is $\frac{15}{28}$.
 $\frac{3}{4}) \frac{15}{28}$ nearly $\frac{15}{28}$ or $\frac{15}{28}$.

Reduction of Decimal Fractions.

A decimal fraction differs only from a vulgar fraction in this, that the denominator of a decimal fraction is either 10, or some power of 10, viz. 100, 1000, 10000, &c. so that the denominator is easily known without expressing it; for in a decimal fraction there is a point or prick towards the left-hand of the numerator, which point always possesses the same place, as the first figure towards the left-hand would, if it were to be wrote down: Thus $\frac{1}{10}$ is .1, the prick being in the ten's place, and therefore denotes the denominator to be 10, $\frac{12}{100}$ is .12, $\frac{125}{1000}$ is .125, $\frac{1964}{10000}$ is .1964, &c.

The way to reduce a Vulgar Fraction to a Decimal is by this proportion.

Rule.] As the denominator of the vulgar fraction given is to it's numerator:

So is 1000,

To the numerator of the decimal whose denominator is 1000:

Or so is 10000 to the numerator of the decimal, whose denominator is 10000, &c.

Example.

Example. What is $\frac{1}{8}$ in a decimal fraction? See the operation.

$$8 : 1 :: 1000$$

$$\underline{1}$$

$$8 \overline{) 1000}$$

.125 Answ.

But because it sometimes happens that a cypher more is to possess the 1, 2, &c. place of the decimal towards the left-hand, therefore take this

Rule.] As many cyphers as you have in the third number of the 3 given, as above, so many places must you prick off in the quotient toward the right-hand.

Example. How is 9d. expressed in the decimal of a pound sterling?

Rule.] Consider, that in a pound there are 240 pence; therefore 9d. is $\frac{9}{240}$ in a vulgar fraction; for 9d. is $\frac{1}{3}$ of $\frac{3}{8}$ of a pound.

Then say as the last example,

$$240 : 9 :: 10000$$

$$\underline{9}$$

$$240 \overline{) 90000} (.375 \text{ Answer.}$$

$$\underline{.180}$$

$$\underline{.120}$$

0 Remains.

In

In this example it is plain there are but three places in the quotient; and as by the rule there should be four, prefix a cypher to the left of such quotient, and prick them off for decimals. When any thing remains, four decimal places will generally be sufficiently near the truth, and frequently three, or sometimes two.

To find the value of a Decimal Fraction in its proper denominations.

Rule.] Consider how many of the next inferior denomination make an unit in the denomination of the decimal, and multiply by it; pointing off as many places in the product from the right hand as are contained in the given decimal, and those on the left will be whole numbers. In like manner proceed for the next lower denomination, with the decimal only of such product, and so on, till you have brought it down to the lowest.

Example. What is the proper value of .535 of a pound sterling?

$$\begin{array}{r}
 .535 \text{ Parts of a pound sterling.} \\
 20 \text{ Shillings make a pound.} \\
 \hline
 11.700 \\
 12 \text{ Pence make a shilling.} \\
 \hline
 8.400 \\
 4 \text{ Farthings make a penny.} \\
 \hline
 1.600
 \end{array}$$

Ans. 11s. 8d. $\frac{1}{4}$. 600 parts.

Addition of Decimal Fractions.

All the difference between this and whole numbers consists in placing the several parts under those of the same value, whether they end equally at the right hand or not, as the separating points must always be under each other: by this means the integers, or

X

whole

whole numbers, will always be on the left, and the decimal places on the right. Those decimal places next the point will be always under each other next on the right hand; and those which are two places from it will in like manner stand under each other, and so of the rest.

Examples.

3.47	.8367	43.2
16.342	.04531	7.835
9.81	.6207	67.71
33.7	.41306	42.03
8.467	.35087	215.005
231.608	.7063	9.35
17.35	.507	25.087
320.747	3.47994	410.217

Note, That the first decimal place to the right hand of the separating point is called tenth parts, or primes; the second is called hundredth parts, or seconds; the next thousandth parts, or thirds; the fourth ten thousandth parts, or fourths; the next hundred thousandth parts, or fifths, &c. &c.

Subtraction of Decimal Fractions.

Place the numbers as in Addition; only observe, that the integers or fractions greatest in value be placed above, whether they consist of more or fewer figures.

Examples.

From	63.23	81.3	171.01
Take	17.39	26.573	64.2373
Remains	45.84	54.727	106.7727

Note,

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Note, That in the second and third examples, where the number of decimal places in the lower line exceed those in the upper, the subtraction is made as if they were supplied with cyphers.

Multiplication of Decimal Fractions.

Here the numbers must be placed as in whole numbers, without any regard to the separating point, or to the value of the factors, and the operation performed in like manner; setting off as many places in the product as both factors contain for decimals; and if there are not sufficient, prefix as many cyphers as will make them equal.

Examples.

64.7 5.9 	43.27 .046 	7.635 9.03
5823 3235 	25962 17308 	22905 687150
381.73 	1.99042 	68.94405
5.487 97.6 	3.485 709.4 	80.673 650.08
32922 38409 49383 	13940 31365 243950 	645384 40336500 484038
535.5312 	2472.2590 	52443.90384

X 2

Division

Division of Decimal Fractions.

The operation of this is the same as in whole numbers: then to find how many decimal places must be pricked off in the quotient, observe how many places are in the dividend, from which deduct the number contained in the divisor, and cut off from the right hand of the quotient the number of places remaining; and if there are not so many in the quotient, prefix as many cyphers as are wanting.

Example. Divide 5473.23 by 67.857.

$$67.857 \overline{) 5473.230000} (80.658$$

$$542856 \dots$$

$$\underline{446700}$$

$$407142$$

$$\underline{395580}$$

$$339285$$

$$\underline{562950}$$

$$542856$$

$$(20094)$$

Note, That as many cyphers are added to the dividend in this example as to make it contain three more decimal places than the divisor, which therefore are pricked off from the right hand in the quotient.

Example. Divide 6.257 by 857.63.

$$857.63 \overline{) 6.2570000} (.00729$$

$$600341 \dots$$

$$\underline{253590}$$

$$171526$$

$$\underline{820640}$$

$$771867$$

$$(48773)$$

As one of the most useful and necessary parts of land surveying, and other kinds of measuring, require a knowledge of the Square Root, it may be proper to present that and the Cube Root, with some of their uses, in this place.

EXTRACTION of the SQUARE ROOT.

TO extract the Square Root, is to discover the root or first number, of which the number given to be extracted is the square, or second power, produced by multiplying such root or number by itself; as 5 by 5, 9 by 9, 27 by 27, &c.

Point the given number, whether whole numbers or decimal fractions, or both, into periods of two figures, always placing the first over the place of units, in whole numbers (if any), but if none, over the second place, to the right hand of the decimal point, supplying the period with cyphers in the decimals, if wanted: then consider what single figure, multiplied by itself, will make the nearest number less than the first period to the left hand, whether of one or two figures; so that if the first period be 23, then will 4 be the figure to be placed in the quotient, and that multiplied by itself is 16, to be put under the 23, and being subtracted from 23, will leave 7 for a remainder, to which bring down the first figure of the next period of two figures, which we will suppose to be 04, when it will be 70. For this a divisor must be found, which is always thus:—double the figure, or figures, in the quotient, and put them for a divisor, wherewith to find another quotient figure, and ask how often such divisor is contained in that dividend, and place the figure both in the divisor and root, and also bring down the other figure of that period for a full dividend. Multiply the divisor by the last quotient figure, and if the product exceeds the full dividend, lessen the quotient figure till you can subtract the product from it, and proceed with the remainder and the next period as with the last, always finding a new divisor, till the work is done.

Note, It sometimes happens that the product is greater than the respective full dividend, and yet that lessening the quotient figure by unity shall occasion the remainder to exceed the divisor; in this case, the next quotient figure will commonly be 9, and the work, notwithstanding, will proceed regularly. If, after you have gained a sufficient number of decimals, there still continues a remainder, the work may be concluded; because, by adding periods of cyphers, it might be carried on without end.

Example 1. *What is the Square Root of 2304?*

$$\begin{array}{r}
 \begin{array}{c} \cdot \cdot \\ 2304 \end{array} \text{ (48 Answer.} \\
 \begin{array}{c} 16 \cdot \\ \hline 38 \end{array}) \begin{array}{c} 704 \\ 704 \\ \hline \dots \end{array}
 \end{array}$$

Example 2. *Required the Square Root of 73549.44?*

$$\begin{array}{r}
 \begin{array}{c} \cdot \cdot \cdot \cdot \\ 73549.44 \end{array} \text{ (271.2 Answer.} \\
 \begin{array}{c} 4 \\ \hline 47 \end{array}) \begin{array}{c} 335 \\ 329 \\ \hline 541 \end{array}) \begin{array}{c} 649 \\ 541 \\ \hline 5422 \end{array}) \begin{array}{c} 10844 \\ 10844 \\ \hline \dots \end{array}
 \end{array}$$

Example

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Example 3. *What is the first Power or Root of 647527.354?*

$$\begin{array}{r}
 \begin{array}{ccccccc}
 \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
 6 & 4 & 7 & 5 & 2 & 7 & . 3 & 5 & 4 & 0 & (8 & 0 & 4 . 6 & 9
 \end{array} \\
 64 \\
 \hline
 1604 \overline{) 7527} \\
 6416 \\
 \hline
 16086 \overline{) 111135} \\
 96516 \\
 \hline
 160929 \overline{) 1461940} \\
 1448361 \\
 \hline
 (13579)
 \end{array}$$

Note, That in this example I first supply the odd figure with a cypher, to complete the period of two figures ; and if to the remainder another period of two cyphers had been brought down, the quotient figure would have been a cypher, and the addition of a period of two cyphers more would, to its respective divisor, produce 8 for a quotient figure.

EXTRACTION of the CUBE ROOT.

TO extract the Cube Root, is to discover the root or first number, of which the number given to be extracted is the cube, or third power, produced by multiplying such root or number by itself, and that product again by the same root ; as 5 by 5, and the product of these again by 5 ; 9 by 9, and that product again by 9, &c.

Point the given number, whether whole numbers or decimal fractions, or both, into periods of three figures, always placing the first over the place of units in whole numbers (if any), but if none, over the third place, to the right hand of the decimal point, supplying the period with cyphers in the decimals, if wanted.

Then

Then consider what single figure, for which the table annexed will be useful, multiplied by itself, and the product again by such figure, will make the number next less than the first period to the left hand, and place such single figure in the quotient or root, and its cube under the first period, subtracting it, and to the remainder bringing down the next period of three figures or cyphers for a dividend. Multiply the square of the quotient or root already found by 300 for a divisor, and try how often the divisor can be had in the dividend (which must not be more than 9 times), and, having placed such figure in the root, and drawn a line under the dividend, multiply the divisor by it, setting down the product under such line. Then square the last quotient figure, and multiply it by the rest of the figures in the root or quotient, and that by 30, which set down under the former product, and under both the cube of the last figure; subtract the sum of these three numbers from the dividend, and to the remainder bring down a new period for a new dividend, and proceed for the divisor, &c. as before.

Note, What I have observed of any product's being greater in extracting the square root than the respective full dividend, and of lessening the quotient figure by unity, so as to occasion the remainder to exceed the divisor, is more common here, and therefore should not prevent the regular process of the work. The following table will be of use to discover readily the first figure of the root, and for giving the first divisor; for the divisor differs here for every figure placed in the quotient or root.

Roots or 1st Power.	1	2	3	4	5	6	7	8	9
Cubes.	1	8	27	64	125	216	343	512	729
First Divisors.	300	1200	2700	4800	7500	10800	14700	19200	24300

Example

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Example 1. *What is the Cube Root of 31855013?*

31855013 (317 Answer.
27

$$\begin{array}{r}
 2700 \overline{)4855} \\
 \underline{2700} \\
 90 \\
 \underline{1} \\
 2791 \\
 \underline{288300} \overline{)2064013} \\
 \underline{2018100} \\
 45570 \\
 \underline{343} \\
 2064013 \\
 \underline{} \\
 \dots\dots\dots
 \end{array}$$

$$\begin{array}{r}
 31 \quad 7 \\
 \underline{31} \quad 7 \\
 31 \quad 49 \\
 \underline{93} \quad 31 \\
 961 \quad 49 \\
 \underline{300} \quad 147 \\
 288300 \quad 1519 \\
 \quad \quad \underline{30} \\
 \quad \quad 45570
 \end{array}$$

Example

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Example 2. What is the Cube Root of 17034106517?

17034106517(2573 Answer.
8

1200)9034	25	7	
6000	25	7	
1500	125	49	
125	50	25	
7625	625	245	
	300	98	
187500)1409106	187500	1225	
1312500		30	
36750			
343		36750	
1349593			
19814700)59513517	257	3	257
59444100	257	3	9
69390	1799	9	2313
27	1285		30
	514		
59513517	66049		69390
.....	300		
	19814700		

Note, That in the preceding operation the second figure in the root is only 5, though the divisor is contained 7 times in the dividend. But it is evident that the numbers to be added to it are large; and though the remainder considerably exceeds the divisor, yet as the second divisor increases so much, the necessity is plain and obvious.

Example

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Example 3. Required the Cube Root of 810546.421?

810546.421 (93.237 Answer.			
729			
24300)81546	3	93	2
	3	93	2
72900	9	279	4
2430	9	837	93
27			
	81	8649	372
75357	30	300	30
2594700)6189421	2430	2594700	11160
5189400	932	3	932
11160	932	3	9
8			
	1864	9	8388
5200568	2796		30
	8388		
260587200)988853000			251640
	868624		
781761600	300		
251640			
27	260587200		
782013267	9323	7	9323
	9323	7	49
36075498700)206839733000			
	27969	49	83907
182528450900	18646		37292
13704810	27969		
343	83907		456827
			30
182542156053	86918329		
	300		13704810
24297576947			
	26075498700		

Note, That in this operation, to obtain the second and third decimal places in the root, periods of cyphers are

are annexed to the remainders. In like manner the work might be continued without end, but three places are in general sufficient.

The USE of the SQUARE ROOT.

IF the root of any square number, or side of any square superficies, or diameter of any circle, be given, to find the root of any other square number, side of a square superficies, or diameter of any circle, so as to bear any required proportion, multiply the square of such root, side, or diameter, by the number which shews that proportion; and the square root of that product will be the root, side, or diameter required.

Example. Suppose the floor of a malt kiln to be 13.5 feet square, what will be the side of a square which shall contain three times the quantity, when laid of the same thickness or depth?

$$\begin{array}{r}
 13.5 \\
 13.5 \\
 \hline
 675 \\
 405 \\
 \hline
 135 \\
 182.25 \\
 3 \text{ Ratio.}
 \end{array}$$

$$\begin{array}{r}
 546.75 (23.38 \text{ Answer.} \\
 4
 \end{array}$$

$$\begin{array}{r}
 43)146 \\
 129 \\
 \hline
 17
 \end{array}$$

$$\begin{array}{r}
 463)1775 \\
 1389 \\
 \hline
 386
 \end{array}$$

$$\begin{array}{r}
 4668)38600 \\
 37344 \\
 \hline
 1256
 \end{array}$$

$$(1256)$$

Note,

Note, This may be applied to laying out square or circular plots of ground in any proportion, or to the size of water pipes for filling cisterns in houses, &c.

The time of heavy bodies falling through the air by their own weight, may be found by knowing the height of the place from whence they fall; and, on the contrary, the height from the time. For as it has been found by experiment, that a heavy body near the earth's surface will fall $16\frac{1}{2}$ feet in the first second of time, and that the fall is accelerated in proportion to the square of the time in falling, it follows, that if the height be given to find the time, such height must be divided by $16\frac{1}{2}$ feet (as taught by case 7, p. 227), and the square root of the quotient extracted for the time in seconds. Or, if the time be given, multiply the square of it in seconds by $16\frac{1}{2}$ feet, and the product will be the height in feet.

Example 1. In what time will a stone fall from the top of the spire of Salisbury Cathedral, by its own weight, supposing it to be 410 feet high?

$$\begin{array}{r} 16\frac{1}{2} \\ 12 \overline{) 193} \end{array}$$

$$\begin{array}{r} 25.492227(5.048 \\ 25 \overline{) 25.492227} \\ 1004)4922 \\ 4016 \overline{) 90627} \\ 80704 \overline{) 9923} \end{array}$$

Ans. 5.048 Seconds

$$\begin{array}{r} 410 \\ 12 \overline{) 4920} 25.492227 \\ 386 \overline{) 1060} \\ 965 \overline{) 950} \\ 772 \overline{) 1780} \\ 1737 \overline{) 430} \\ 386 \overline{) 440} \\ 540 \overline{) 1351} \\ 1351 \overline{) 189} \end{array}$$

Y

Example

Example 2. We read in the heathen mythology, that JUPITER, being enraged at VULCAN, threw him out of heaven, and that his fall to the island of Lemnos, where he was found, took up a whole summer's day. The longest day in that island is about 14 hours and 40 minutes, and if he fell at the rate of other heavy bodies, I would wish to know the height of this poetical heaven? *Answer*, 8492000 Miles.

It has been discovered by experience, that a pendulum of a clock at and near London, to vibrate seconds, or 60 times in a minute, must be 39.2 inches long; but as pendulums are frequently required of different lengths, it is known that these are reciprocally proportional to the square of the number of their vibrations in a minute; and from hence we have this rule: As the length of a second pendulum, is to the square of the number of its vibrations in a minute, so is the proposed length of another pendulum, to the square of its number of vibrations, of which extract the square root. If the number of vibrations are given, and the length required, reverse the terms.

Example. If the length of a second pendulum be 39.2 inches, what is the length of a pendulum which shall measure half seconds, or vibrate 120 times in a minute?

	Vibr.	Inch.		Vibr.
As	60	: 39.2	::	120
	60	3600		120
	3600	235200		14400
		1176		

144|00)1411|20.0(9.8 Inches, Answer.

1296

1152

1152

....

For many other uses of the Square root, I must refer to the examples in Trigonometry, Surveying, &c.

The

The USE of the CUBE ROOT.

IF the root of any cube number, or the side of any cubic or solid body, or measure of capacity, or diameter of any sphere or globe, be given, to find the root of any other cube number, side of any solid body, or diameter of any sphere or globe, so as to bear any required proportion, multiply the cube of such root, side, or diameter, by the number which shews that proportion, and the cube root of that product will be the root, side, or diameter required.

Example 1. If a maltster has a cistern, whose side is exactly 40 inches, and of a cubical form, and he wishes to have another to hold half as much more in quantity, and of a like form, what will be the side of it?

$$\begin{array}{r}
 40 \\
 \hline
 40 \\
 \hline
 1600 \\
 40 \\
 \hline
 64000 \\
 1.5 \\
 \hline
 320000 \\
 64000 \\
 \hline
 96000.0 \text{ (45.8 Inches nearly, Answer.} \\
 64 \\
 \hline
 4800 \overline{) 32000} \\
 \underline{24000} \\
 8000 \\
 \underline{3000} \\
 5000 \\
 \underline{125} \\
 27125 \\
 607500 \overline{) 4875000} \\
 \underline{4800000} \\
 75000 \\
 \underline{86400} \\
 8600 \\
 \underline{512} \\
 4946912
 \end{array}$$

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Example 2. If a cannon ball of 4 inches diameter weigh 12lb. what will be the diameter of a ball of 24lb?

	lb.		Inch.		lb.
As	12	:	4	::	24

$$\begin{array}{r}
 4 \\
 \hline
 16 \\
 4 \\
 \hline
 64 \\
 24 \\
 \hline
 256 \\
 128 \\
 \hline
 12 \overline{)1536} \\
 \hline
 128(5.04 \\
 125 \\
 \hline
 750000 \overline{)3000000} \\
 \hline
 3000000 \\
 24000 \\
 64 \\
 \hline
 3024064
 \end{array}$$

Note, That in both these examples, the last figure of the root is a little too much, but differs so little from truth, as to be imperceptible when applied to use.

Hence it is, that the tonnage of shipping is computed in proportion to ships of larger or smaller dimensions; for if you have the length of the keel of any ship, with her burden, the burden of any other ship built in like manner may be had, by having the length of her keel: or, the length of the keel may be determined by the proposed burden; for as the cube of the keel of the given ship is to her burden, so is the cube of the keel proposed, to her corresponding burden; and, by reversing

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versing the terms, the length of the keel may be known from the burden.

Example 1. Suppose the burden of a ship of 80 feet in the keel to be 600 tons, what will be the burden of a vessel, whose keel is but 40 feet?

Feet.	Tons.	Feet.
As 80	: 600	:: 40
80		40
6400		1600
80		40
512000		64000
		600

512|000)38400|000(75 Tons, Answer.
3584

2560

2560

.....

Y 3

Example

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Example 2. If a ship of 40 feet in the keel be 75 tons burden, what keel must that ship have, whose burden is 1000 tons?

Tons.	Feet.	Tons.
As 75	: 40	:: 1000
	40	
	1600	
	40	
	64000	
	1000	
75)64000000		(853333.333333(94.85 Feet,
600.....		729 Anfw.
400	24300)	124333
375		97200
250		4320
225		64
250		101584
225	2650800)	22749333
250		21206400
225		180480
250		512
225		21387392
250 &c.	269611200)	1361941333
		1348056000
		711000
		125
		1348767125
		(13174208)

Note,

Note, That the remainder in the division being always 25, the quotient figure, of which the cube root is to be taken, will be always 3.

For some other examples, wherein the square and cube roots are jointly exercis'd, relating to the laws of the heavenly bodies, shall be introduced in treating of Astronomy.

RULES of PRACTICE.

IT is usual to give this name to certain short and compendious ways of casting up the value of merchandise, as being shorter than those of Multiplication or Proportion, and is commonly performed by taking the aliquot, or even parts of a pound, shilling, &c. for the price of an integer. Thus 2d. is the sixth part of a shilling, because there are so many times 2d. in a shilling; 3d. is the fourth part, &c. The following tables will, if properly got by heart, with a few examples, make it easy.

TABLE I. *The Aliquot Parts of a Shilling.*

d.	q.		
1		} is one	{ 12th
1	2		
2			
3			
4			
6			
			{ 8th
			{ 6th
			{ 4th
			{ 3d
			{ half

of a Shilling.

TABLE

TABLE II. *The Aliquot Parts of a Pound.*

s.	d.		
	6	} is one	{ of a Pound.
	8		
	10		
1			
1	8		
2			
2	6		
3	4		
4			
5			
6	8		
10			
			40th 30th 24th 20th 12th 10th 8th 6th 5th 4th 3d half

Example 1. *What will 327 yards of cloth come to at 4s. per yard?*

$$\begin{array}{r|l} \text{s.} & \text{£.} \\ 4 & \frac{1}{5} \end{array} \quad \begin{array}{r} 327 \\ \hline 65 \end{array}$$

As 4s. is the 5th of a pound, therefore by taking the 5th part of 327, the given quantity, the quotient 65 will be the answer in pounds, and the two which remains will be so many times 4s. or 65l. 8s. the true answer.

Example 2. *What will 519lb. of any commodity cost, at 6d. per lb.?*

$$\begin{array}{r|l} \text{d.} & \text{s.} \\ 6 & \frac{1}{2} \end{array} \quad \begin{array}{r} 519 \\ \hline 259 \end{array} \quad \begin{array}{r} 6 \\ \hline 12 \end{array}$$

As 6d. is the half of a shilling, therefore by taking the half of 519, the given quantity, the quotient 259 will be the answer in shillings, and the one which remains will be equal to the given price, that is 6d. and reduce the said quotient by 20 into pounds, because 20 shillings are a pound, and then the answer is 12l. 19s. 6d.

Example

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Example 3. *What is the value of 431 yards of any article, at 2s. 6d. per yard?*

s. d.

$$\begin{array}{r|l} 26 & \frac{1}{8} \mid 431 \\ \hline & 53 \text{ l. } 17 \text{ s. } 6 \text{ d.} \end{array}$$

Here 2s. 6d. is the 8th of a pound, by which the given quantity 431 is to be divided, and the quotient will be 53l. and as the 7 remaining is so many times 2s. 6d. therefore the answer is 53l. 17s. 6d.

In like manner all other questions may be resolved, where the price is an aliquot part of a shilling or pound, whether consisting of pence or farthings only, or of pence and farthings; or again of shillings, or of shillings and pence. But when the given price is not the aliquot part of a shilling, take some aliquot part less; and for what is wanting, take the part or parts of that, till the several parts are equal to it; as in the following examples:

Example 4. *What is the value of 537 ells of cambric, at 5s. 4d. per ell?*

s. l.

$$\begin{array}{r|l} 5 & \frac{1}{4} \mid 537 \\ \hline 4 & \frac{1}{15} \mid 134 \text{ } 5 \\ & 8 \text{ } 19 \\ \hline & 143 \text{ l. } 4 \text{ s.} \end{array}$$

In this example, 5s. is the 4th of a pound, and the remaining 4d. is the 15th part of 5s. so that, first, the 4th of 537 is 134l. 5s. and the 15th of 134l. 5s. is 8l. 19s. which together make 143l. 4s. the value required; for as 4d. added to 5s. make the full price of one ell, so the value of the given quantity at 4d. or 8l. 19s. added to the value at 5s. or 134l. 5s. must give the whole value of the given quantity at the given price.

Example

Example 5. Required the value of 509 dozen of any article of merchandise, at $3s. 7d\frac{1}{2}$. per dozen?

s. d.	l.	
3 4	$\frac{1}{2}$	509
2	$\frac{1}{20}$	84 16 8
1	$\frac{1}{2}$	4 4 10
$\frac{1}{2}$	$\frac{1}{2}$	2 2 5
		1 1 $2\frac{1}{2}$

In the first place, $3s. 4d.$ the aliquot part next less than the price is one sixth, and $2d.$ is one 20th of that, and $1d.$ is half of that, and a halfpenny is

$92l. 5s. 1d\frac{1}{2}$. Answ. one half of $1d.$ which sums together just make up the price; and the sum of the several quotients must in like manner be the true value of the given quantity, and the answer to the question. And thus may the value of any quantity be readily found, at almost any other price, so that one observation more will be fully sufficient for the common cases of Practice; which is, when the price is equal to any number of shillings.

If the price is any even number of shillings, or such as can be divided by 2 without a remainder, then multiply the units of the given quantity by the whole price for shillings, and carry the pounds; then multiply the rest of the quantity by half the price, adding to the product the pounds you carried forward. But if the price given is an odd number of shillings, multiply the quantity by such price, and divide the product by 20 for the answer in pounds. And if the price consist of pounds and shillings, the given quantity multiplied by such price, and added to the value of the said quantity, at so many shillings, will give the whole value at the price proposed.

Example 6. Required the value of 713 sheep, at 12s. each?

71 3
6 12

Here I place the 3 in the place of units, by itself, to be multiplied by the given price,

427l. 16s. Answ. setting down the 16 shillings of the product, and carrying one pound; then multiply the rest of the figures, or 71, by the half price, adding to the product the one pound carried, and the answer will be 427l. 16s. for the true value.

Example

Example 7. *What is the value of 583lb. of tobacco, at 3s. per lb?*

$$\begin{array}{r} 583 \\ 3 \\ \hline 210 \overline{)1749} \end{array}$$

87l. 9s. Answ.

In this operation, it is obvious that the given quantity is multiplied by the price, and the product divided by 20, which makes the answer 87l. 9s.

T A R E and T R E T T.

THIS branch it has been thought proper to annex to Practice, as having some degree of affinity therewith, the Tare being commonly found or deducted by means of taking the aliquot parts. But first I must premise, that Tare is the allowance made for the package of goods, at so much per bag, box, &c. or at so much per cwt. or at so much in the whole gross weight, *i. e.* the full weight both of goods and package. Trett is also an allowance of 4lb. in every 104lb. for waste, &c. Cloff is also an allowance of 2lb. for every 3 cwt. on some sorts of goods. Suttle is a term used, when any part of the allowances has been deducted, whether one or more, when any remain to be deducted; and Neat, is the pure weight after all deductions are made. To have by heart the following tables will be useful.

TABLE I. *The Aliquot Parts of a Ton.*

C.	qr.	lb.				
1			12	} is one	{	20th 10th 8th 7th 5th 4th half
2						
2	2					
2	3					
4						
5						
10						
						} of a Ton.
				{		

TABLE

TABLE II. *The Aliquot Parts of an Cwt.*

$$\begin{array}{l} \text{lb.} \\ 14 \\ 16 \\ 28 \\ 56 \end{array} \left. \vphantom{\begin{array}{l} 14 \\ 16 \\ 28 \\ 56 \end{array}} \right\} \text{ is one } \left\{ \begin{array}{l} 8^{\text{th}} \\ 7^{\text{th}} \\ 4^{\text{th}} \\ \text{half} \end{array} \right\} \text{ of an Cwt.}$$

TABLE III. *The Aliquot Parts of a Qr. Cwt.*

$$\begin{array}{l} \text{lb.} \\ 3\frac{1}{2} \\ 4 \\ 7 \\ 14 \end{array} \left. \vphantom{\begin{array}{l} 3\frac{1}{2} \\ 4 \\ 7 \\ 14 \end{array}} \right\} \text{ is one } \left\{ \begin{array}{l} 8^{\text{th}} \\ 7^{\text{th}} \\ 4^{\text{th}} \\ \text{half} \end{array} \right\} \text{ of a Qr. Cwt.}$$

Example 1. *Required the neat weight of 24 hog-sheads of Sugar, each 7 cwt. 2 qr. 14 lb. Tare, at 14 lb. per cwt?*

Cwt. qr. lb.	
7 2 14	
	6
45 3 0	
	4
lb.	
14 $\frac{1}{8}$	183 0 0 Gross.
	22 3 14 Tare.
Cwt. 160 0 14	Answer.

Example 2. *What is the neat weight of 5 hogsheds, weighing together 44 cwt. 3 qr. 14 lb. gross, Tare in all 142 lb. and Trett 4 lb. in every 104 lb?*

Cwt. qr. lb.	
44 3 14	Gross.
1 1 2	Tare.
26	43 2 12
	1 2 19 Trett.
Cwt. 41 3 21	Answer.

These

These examples will suffice to shew the nature and importance of this rule, and the expediency of paying attention to it. Loss and Gain, Barter, Exchange, &c. may be passed over, because all of them may be done either by the Rule of Three, or the Rules of Practice already explained.

Of DUODECIMALS, with their Uses.

THE foundation of Duodecimals is, that as the foot is divided into 12 inches, so the inch is divided into 12 parts, called seconds, and that again is supposed to be divided into 12 other parts, called thirds, and so on without end.

Examples of Addition.

<i>Feet. In. " "</i>	<i>Feet. In. " " "</i>
17 6 7 9	137 5 8 2 5
25 8 6 4	84 3 5 7 6
38 9 4 2	23 0 7 6 2
6 4 9 3	205 4 6 3 4
19 11 5 8	47 7 4 2 8
26 5 4 7	26 3 0 8 0
11 4 8 6	61 6 2 4 9
146 2 10 3	585 6 10 10 10

Note, That in the former example you begin with thirds, marked with three dashes, and in the second with fourths, having four marks, and in each carry one for every 12.

Examples of Subtraction.

	<i>Feet. In. " "</i>	<i>Feet. In. " " "</i>
From	73 5 8 1	321 3 2 8 3
Take	27 6 9 5	176 5 7 11 6
	Remains 45 10 10 8	144 9 6 8 9

Z

Examples

Examples of Multiplication.

	<i>Feet. In.</i>		
Multiply	9	7	
by	5	6	
	47	11	"
	4	9	6

Answ. 52 8 6

	<i>Feet. In.</i>		
	11	5	
	4	7	
	45	8	"
	6	7	11

52 3 11

Note, That in the former example, the 7 inches are first multiplied by the 5 feet, which making 35, I set down 11 inches, and carry two feet, which added to the product of the feet, will make 47 feet; then multiply the 7 inches by the 6 inches, and the product will be 42 seconds (for inches multiplied by inches give seconds), where I set down 6 seconds, one place removed to the right hand, as above, and carry 3 inches; and having multiplied the 9 feet by the 6 inches, with the 3 inches added, will make 57 inches, or 4 feet 9 inches; and, lastly, add the two lines together for the product. And in like manner all others, consisting of feet and inches only, if the feet in the multiplier are not more than 12, are performed.

If either the multiplier or multiplicand, or both, have seconds, the same rule will do for the seconds, only observing, that seconds by seconds give fourths, and inches by seconds give thirds, &c. In like manner for any number of denominations, only increasing one line for each additional denomination of the multiplier.

	<i>Feet. In.</i>		
Multiply	57	7	
by	23	9	

171

114

13

5

"

8

43

2

3

"

8 Answ. 1367 7 38

Feet. In.

33 5

19 8

297

33

7 11

22 3 4

657 2 4

Note,

Note, In the first preceding example, the feet being more than 12, the feet in the multiplicand are multiplied by the feet in the multiplier, which form the two first lines of the product, and then the inches of the multiplicand by the feet in the multiplier, which makes the third line. Again the multiplicand is multiplied by the inches of the multiplier, and the product in feet, inches, and seconds, is set down in the fourth line, and the sum of the four lines will be the product. Thus all other examples of this nature are done, whether they consist of two, three, or more denominations, increasing one line for each additional denomination in the multiplier.

The Application to ARTIFICERS WORK.

Example 1. A glazier, having finished the lights of a gentleman's villa, finds his account to stand as follows: The first range of windows measured 137 feet, 9 inches, 9 seconds; the second measured 111 feet, 4 inches, 6 seconds, 7 thirds; and the upper story 87 feet, 3 inches, 3 seconds, on the south side; on another side the first range was 99 feet, 6 inches, 6 seconds; the second was 75 feet, 4 inches, 8 seconds, 5 thirds, 3 fourths; and the upper range, or attic story, was 51 feet, 5 inches, 9 seconds; the lights of stair cases, and other irregular windows, amounted to 137 feet, 3 inches. How many feet did the whole contain? *Answ.* 700 feet, 1 inch, 6 seconds, 0 thirds, 3 fourths.

Note, That these quantities are supposed severally to be found by Multiplication of Duodecimals, as already shewn; and will further appear in these examples.

Example 2. A mason measured several pieces of paving done by his workmen, of which the first was 67 yards, 5 feet, 3 inches, 9 seconds; the next was 57 yards, 6 feet, 7 inches; the third measured 39 yards, 8 feet, 6 inches, 10 seconds; the fourth contained 106 yards, 2 feet, 6 inches, 3 seconds; and a fifth was 76 yards, 4 feet. How many yards did these five pieces

of workmanship contain? Answ. 347 yards, 8 feet, 11 inches, 10 seconds.

Note, That in paviours, and all other work done by the yard square, 9 feet are equal to one yard.

Example 3. A carpenter laid several floors in a gentleman's new villa, which measured as follows: The first was 1 square, 3 quarters, 17 feet, 6 inches; the second contained 1 square, 1 quarter, 11 feet, 7 inches, 4 seconds; a third contained 2 squares, 0 quarters, 15 feet, 3 inches; and a fourth was 1 square, 2 quarters, 3 feet, 0 inches, 5 seconds. How much was the whole? Answ. 6 squares, 3 quarters, 22 feet, 4 inches, 9 seconds.

Note, That in flooring, partitioning, and works which are measured by the square, 25 feet are equal to one quarter, and 4 quarters to a square, or 100 feet are equal to one square. All these are done by addition only.

Example 4. A joiner having finished some rooms very curiously, in order to estimate the charge, sums up the whole to be 573 feet, 6 inches, 2 seconds, 3 thirds, out of which he is to make several deductions for doors, windows, &c. as separate workmanship, amounting to 76 feet, 9 inches, 5 seconds, 7 thirds, 3 fourths. How many feet must he charge for? Answ. 496 feet, 8 inches, 8 seconds, 7 thirds, 9 fourths.

Note, That this and the two following are done by Subtraction.

Example 5. A carpenter having purchased several parcels of boards, amounting to 401 feet, 1 inch, wrought up the quantity of 167 feet, 5 inches, 6 seconds. How many feet remained? Answ. 233 feet, 7 inches, 6 seconds.

Example

Example 6. The area of a gentleman's court was 226 yards, 5 feet, 7 inches, which was to be laid with aihlar, in such a manner, as to leave a square in the middle, containing 89 yards, 7 feet, 9 inches, 8 seconds. What quantity was to be laid down? Answ. 136 yards, 6 feet, 9 inches, 4 seconds.

Example 7. The chancel of a church was to be paved with marble, whose length was 30 feet, 6 inches, 3 seconds, and the breadth 18 feet, 4 inches, 6 seconds. How many square feet did it contain? Answ. 560 feet, 9 inches, 10 seconds, 1 third, 6 fourths.

Note, That masons very often measure their work by square feet, in laying aihlar, marble, &c. Glaziers also measure by the foot square. This and the following question are performed by Multiplication only.

Example 8. The windows of a gentleman's house were to be new glazed, and their size was as follows: Five were 5 feet 6 inches high, by 3 feet, 4 inches, 3 seconds broad; four more were 4 feet, 9 inches, 6 seconds high, by 2 feet 9 inches broad; and three more were 3 feet, 8 inches, 3 seconds in height, by 7 feet, 3 inches, and 6 seconds in length. How many feet of glazing did the whole contain? Answ. 225 feet, 7 inches, 4 seconds, 1 third, 6 fourths.

Example 9. A room was to be plaistered, the two end walls of which were 13 feet 3 inches broad, and the height of the room was eight feet 3 inches. How many yards of plaistering must be charged, supposing the length of the room to have been 16 feet 6 inches? Answ. 54 yards, 4 feet, 10 inches, 6 seconds.

Note, That the best way of computing by square yards is, first to compute by feet, and to divide the product in feet by 9 for the square yards.

Example 10. If a floor be 67 feet 6 inches in length, and 30 feet 3 inches in breadth, how many squares of 100 feet each does it contain? Answ. 20 squares, 1 quarter, 16 feet, 10 inches, 6 seconds.

Note, That the best way is to compute by feet, and to cut off two figures to the right hand for the squares; and if the figures cut off exceed 25, divide by that for the quarters, and the remainder will be feet, as in this and the two following examples.

Example 11. Supposing the area, or floor of Westminster-Hall, allowed to be the largest room in Europe, or perhaps in the world, to be 220 feet 3 inches in length, and 69 feet 9 inches in breadth; how many squares are contained in the said floor? Answ. 153 squares, 2 quarters, 12 feet, 5 inches, 3 seconds.

Example 12. A bricklayer, after roofing a house, measures the depth to be 14 feet 6 inches on the one side, and 16 feet 9 inches on the other, and the length of the house was 34 feet 7 inches; how many squares does the whole contain? Answ. 10 squares, 3 quarters, 5 feet, 8 inches, 9 seconds.

Example 13. A wall of 257 feet 6 inches in length, and 5 feet 9 inches in height, was to be built of a standard thickness, which is a brick and a half; how many rod will the same contain? Answ. 5 rods, 1 quarter, 52 feet, 7 inches, 6 seconds.

Note, That the rod of brick work is 272 feet and a quarter; but it is customary to divide the feet by 272 feet (dropping the quarter), and the remainder, divided by 68, will give the quarters, leaving the residue for the feet. By this method are this and the following example performed, except as there noted.

Example 14. Suppose the same wall was to be built one half at two bricks thick, and the other at standard, or a brick and a half thick; how many rod must be charged for the same? Answ. 6 rods, 1 quarter, 27 feet, 4 inches, 9 seconds.

Note,

Note. That half the height of the wall must here be the multiplier to the given length, and the value of the product found as before; but for the other half at 2 bricks thick, one third must be added to the product, and that sum divided by 272 and 68 as before, both which will be the whole measure.

Example 15. The lower story of a chimney measures thus: the breast wall and the depth of the two sides are together 18 feet 9 inches, and the height of it is 12 feet 6 inches. The second story in like manner measures 14 feet 6 inches, by 9 feet; the third 10 feet 3 inches, by 7 feet, and the compass of the chimney above the roof is 13 feet 9 inches, by 6 feet 6 inches. The depth of the middle fether, which parts the funnels, is 12 feet, and its width 1 foot 3 inches, and the whole is to be measured as double measure; how many rods of 272 feet must be charged? *Answ.* 3 rods, 3 quarters, 62 feet.

Note. That the above example comprehends every thing necessary to be known with respect to the measuring chimney work, and is adopted from an approved author for that purpose.

Example 16. A mason built a wall of 35 feet 6 inches in length, and 19 feet 9 inches in height; how many rod of 63 feet did the same contain? *Answ.* 11 rods, 8 feet, 1 inch, 6 seconds.

Note. That this example is done by feet, and divided by 63, it being customary in some places to reckon 63 feet superficial to the rod, let the thickness be what it may, especially where buildings are of stone.

Example 17. If a stone be 7 feet 6 inches in length, 4 feet 9 inches in breadth, and 3 feet 3 inches in depth; how many solid feet does it contain? *Answ.* 115 feet, 9 inches, 4 seconds, 6 thirds.

Note. That in this and the two following examples, two of the dimensions are first multiplied together, and

and that product by the third, and then the feet contained in the last product are divided by 27, the number of solid feet in a solid yard.

Example 18. A piece of timber was put into a building 19 feet 3 inches long, 1 foot 3 inches broad, and twelve inches thick; how many feet of timber were contained in that piece? *Answ.* 24 feet, 0 inches, 9 seconds.

Example 19. A cellar of 26 feet 3 inches in length, 15 feet 3 inches in breadth, and 7 feet 6 inches in depth, was to be dug; how many solid yards of earth would be removed? *Answ.* 111 yards, 5 feet, 4 inches, 1 second, 6 thirds.

GENERAL OBSERVATIONS, *useful and necessary*
to be known by Artificers and their Employers.

MASONS very frequently measure their work by square feet, or 12 inches in length by 12 inches in breadth; as in laying ashlar, marble, &c. Ashlar is laid as it is cut out of the quarries, so that the thickness is not measured; and marble is laid by the square foot, but valued by the solid foot.

Glaziers in like manner measure by the square foot, and usually take their dimensions to a quarter of an inch, or three seconds. They make no allowances for half rounds, or for oval windows, but measure them as if they were perfectly square, on account of the great trouble in preparing them, and the waste of glass in cutting them.

Carpenters, and some other workmen, also measure their boards, &c. by the foot square; but carpenters sometimes compute by the square of 100 feet.

Paviours, whether they use bricks, tiles, pebbles, &c. usually measure their work by the yard square;
and

and it is observable, that 32 bricks of the statute size will just cover a yard, each brick being 9 inches long, and 4 inches and a half broad.

Plasterers also measure by the yard square, which is usually done either upon lath, and then it is called cieling work; or upon brick walls in partitions, called rendering. They make several allowances, and deduct for all chimney pieces, &c. in cieling, and for all doors, windows, &c. in partitioning: upon brick work in rendering, they allow nothing for doors or windows, unless by custom of particular places, or by agreement. Between quarters, they often allow a fifth part, and sometimes a fourth, if the workman finds stuff, but not else. Floors, &c. laid with lime or sand, in imitation of stone work, are also measured thus.

Joiners make allowances for window lights, or are measured by the piece, or running measures; but if work is done on both sides, they charge for work and half work. Window boards, skirt boards, &c. are measured by themselves; as are chimney pieces, and other ornamental works, and are commonly valued by running measure. In taking the height of rooms, measure every turn of the moulding or cornice, and round the flat part of the room for the compass.

Painters take dimensions as joiners do, and compute their work as once, twice, or thrice coloured; the first of which is called priming. Window lights, casements, and sometimes modillions, with their ornaments, are done at so much a piece. They measure by the yard square, as joiners and plasterers.

Tylers, and persons employed in covering roofs of houses or buildings, whether with tiles, slate, thatch, &c. commonly compute by the square of 100 feet; and not only measure to the extent in taking dimensions, but usually add 18 or 20 inches for the projection over the plate.

In

In flooring, it is common to deduct for all well holes for stair cases, chimney ways, &c. and in partitioning, for doors, door-cases, and windows; but allowances are seldom made for chimney shafts, skylights, &c. in roofing, on account of the trouble.

Bricklayers vary much in computing their work. In some places they measure by the rod of 18 feet square, or 324; in others by the rod of 16 feet square, or 256; and sometimes by the rod of 21 feet long, and 3 feet high, or 63 square feet, the thickness being according to custom; but the last is generally used by stone masons. In measuring chimney work, if they stand alone, girt them about for the length, and take the height for the breadth; but where they stand against a wall which has been measured before, the depth of the two sides, with the breast, must be taken for the length, and the height of the story for the breadth.*

Before we proceed to Geometry, and the dependent branches, it may be proper here to present the student with the nature of board and timber measure, as of great use to artificers; particularly carpenters, joiners, and others conversant in timber, as well as gentlemen.

Of BOARD MEASURE.

IN taking the measure of boards, the thickness is not regarded, though the value of them differs according to the thickness. It is usual to take the length along the middle between the two edges, and the breadth in the middle between the two ends; and to find the content, take the following rule:

If the dimensions were taken in feet and inches, or the length in feet and inches, and the breadth in inches,

* For those who desire to be more fully acquainted with the Nature of any of these several Kinds of Measure, the Young Measurer's Complete Guide, by the late D. Fenning, may with the greatest justice be recommended.

multiply

multiply the length by the breadth, as shewn in Multiplication of Duodecimals, and the product will be the answer in feet, and parts of a foot. Or if both were taken in inches, if the products, as they arise, are turned into the superior denominations, the content will be had as before. In like manner a stock of boards, of the same length and breadth, may be measured, by multiplying the content of one board by the number of boards. Or if the length of the boards be equal, but the breadths different, take the different breadths with a string in one dimension, and multiply that by the length of one board.

Example 1. If a board be 10 feet 6 inches long, and 1 foot 3 inches broad, how many square feet does it contain?

<i>Feet. In.</i>	
10	6
1	3
10	6
2	7 6
Feet 13	1 6 Answer.

Example

Example 2. In 14 boards, each 11 feet 8 inches long, and the middle breadth 11 inches 6 seconds; how many flat or square feet?

Feet. In.

11 8

11 6

10 8 4

5 10 0

Feet 11 2 2 0 in one Board.

7

78 3 2

2

Feet 156 6 4 in the whole, Answer.

Example 3. If the length of a parcel of boards be 9 feet 7 inches, and the sum of their breadths, taken together, be 67 feet 6 inches; how many square feet do they contain?

Feet. In.

67 6

9 7

607 6

39 4 6

Feet 646 10 6 Answer.

But if a board is irregular in its breadth, measure it across in the broadest and narrowest places, which add together, and divide it by the number of breadths taken; and the quotient multiplied by the length gives the content.

Example

UNIVERSAL COMPANION. 265

Example 4. A board, whose length is 13 feet 9 inches, is in breadth as follows: in one place 10 inches 6 seconds, in another 11 inches 3 seconds, in a third 10 inches 9 seconds, in a fourth 12 inches 6 seconds, and in a fifth 12 inches 3 seconds; how many square feet does it contain?

In. Sec.

10	6
11	3
10	9
12	6
12	3

5) 57 3

11	5	5	nearly.

Feet. In.

13	9	"	"
11	5	5	
12	7	3	
	5	8	9
		5	8
			9

Feet 13 1 5 5 9 Answer.

Of TIMBER MEASURE.

As there are various sorts and shapes of timber, there must necessarily be various methods of measuring it, and finding its content. The most usual ways of doing this are here given.

It is common amongst workmen and measurers, and dealers in timber, to gird a tree round the middle with a cord, and take the 4th part of the compass for the side of a square of equal area. This is generally

A a

taken

taken in inches, and the square of that 4th being multiplied by the length in feet, and the product divided by 144, the content in solid feet will be obtained. The purchaser is commonly allowed to gird the tree where he pleases, between the greater end and the middle of the tree.

Example. If the compass of a tree near the middle be 57 inches, and the length 38 feet 6 inches; what is the content in feet?

$$\begin{array}{r} 4 \overline{) 57} \\ \hline \end{array}$$

$$\begin{array}{r} 14.25 \\ \hline \end{array}$$

$$\begin{array}{r} 14.25 \\ \hline \end{array}$$

$$\begin{array}{r} 7125 \\ \hline \end{array}$$

$$\begin{array}{r} 2850 \\ \hline \end{array}$$

$$\begin{array}{r} 5700 \\ \hline \end{array}$$

$$\begin{array}{r} 1425 \\ \hline \end{array}$$

$$\begin{array}{r} 203.0625 \\ \hline \end{array}$$

$$\begin{array}{r} 38.5 \\ \hline \end{array}$$

$$\begin{array}{r} 10153125 \\ \hline \end{array}$$

$$\begin{array}{r} 16245000 \\ \hline \end{array}$$

$$\begin{array}{r} 6091875 \\ \hline \end{array}$$

144)7817.90625(54.291 Feet, Answer.

$$\begin{array}{r} 720 \dots \\ \hline \end{array}$$

$$\begin{array}{r} 617 \\ \hline \end{array}$$

$$\begin{array}{r} 576 \\ \hline \end{array}$$

$$\begin{array}{r} 419 \\ \hline \end{array}$$

$$\begin{array}{r} 288 \\ \hline \end{array}$$

$$\begin{array}{r} 1310 \\ \hline \end{array}$$

$$\begin{array}{r} 1296 \\ \hline \end{array}$$

$$\begin{array}{r} 146 \\ \hline \end{array}$$

$$\begin{array}{r} 144 \\ \hline \end{array}$$

Note,

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Note, That a crooked tree must not be measured on either the hollow or round side of the curve, but on the straight side, bending the string to the shape of the timber.

But if a tree is very unequally thick or taper, gird it in as many places as may be thought necessary, and divide their sum by the number of the girths taken, for the mean girth or compass; and if the fourth part in inches be squared, and multiplied by the length in feet, and divided by 144 as before, the content, according to the customary method, will be obtained.

Example. If a tapering tree is 63 inches round in one place, 57 in another, 52 in another, and 45 in a fourth, nearly at equal distances from each other, and the length 29 feet; what is the content?

$$\begin{array}{r}
 63 \\
 57 \\
 52 \\
 45 \\
 \hline
 4 \overline{) 217} \\
 4 \overline{) 54.25} \\
 \underline{13.56} \\
 \underline{13.56} \\
 8136 \\
 6780 \\
 4068 \\
 \underline{1356} \\
 183\ 8736 \\
 \underline{29} \\
 16548624 \\
 \underline{3677472} \\
 144 \overline{) 5332.3344} (37.03 \text{ Feet, Answer.} \\
 \underline{432} \\
 1012 \\
 \underline{1008} \\
 433 \\
 \underline{432} \\
 1
 \end{array}$$

A a z

Note,

Note. That in all tapering timber, if it gradually diminishes in thickness, the distances of the compasses measured should be equal, and not too near each end.

And if a tree is large, so as to have branches of 24 inches and more in compass, so much of the said branches as measure 24 inches, or upwards, must be considered as timber; but the trunk of a tree, if it does not measure 24 inches in compass, must not be considered as timber, beyond the place where it measures so much.

Example. A tree of 32 feet long has, for its mean compass, 100 inches, with two branches, one of 13 feet long, and 28 inches compass, and another of 11 feet long, and 24 inches compass; what is the content?

$$\begin{array}{r} 4 \overline{)100} \\ \underline{25} \\ 25 \\ \underline{125} \\ 50 \\ \underline{625} \\ 32 \\ \underline{1250} \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{25} \\ 25 \\ \underline{125} \\ 50 \\ \underline{625} \\ 32 \\ \underline{1250} \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{125} \\ 50 \\ \underline{625} \\ 32 \\ \underline{1250} \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{50} \\ 625 \\ \underline{32} \\ 1250 \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{625} \\ 32 \\ \underline{1250} \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{32} \\ 1250 \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{1250} \\ 1875 \end{array}$$

$$\begin{array}{r} \underline{1875} \end{array}$$

$$\begin{array}{r} \underline{20000} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{396} \end{array}$$

$$\begin{array}{r} \underline{144} \end{array}$$

$$\begin{array}{r} \underline{663} \end{array}$$

$$\begin{array}{r} \underline{576} \end{array}$$

$$\begin{array}{r} \underline{873} \end{array}$$

$$\begin{array}{r} \underline{864} \end{array}$$

$$\begin{array}{r} \underline{900} \end{array}$$

$$\begin{array}{r} \underline{864} \end{array}$$

$$\begin{array}{r} \underline{36} \end{array}$$

$$\begin{array}{r} \underline{36} \end{array}$$

$$\begin{array}{r} 4 \overline{)28} \\ \underline{7} \\ 7 \\ \underline{49} \\ 13 \\ \underline{147} \\ 49 \\ \underline{637} \end{array}$$

$$\begin{array}{r} \underline{7} \\ 7 \\ \underline{49} \\ 13 \\ \underline{147} \\ 49 \\ \underline{637} \end{array}$$

$$\begin{array}{r} \underline{49} \\ 13 \\ \underline{147} \\ 49 \\ \underline{637} \end{array}$$

$$\begin{array}{r} \underline{13} \\ 147 \\ 49 \\ \underline{637} \end{array}$$

$$\begin{array}{r} \underline{147} \\ 49 \\ \underline{637} \end{array}$$

$$\begin{array}{r} \underline{49} \\ 637 \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

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$$\begin{array}{r} \underline{637} \end{array}$$

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$$\begin{array}{r} \underline{637} \end{array}$$

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$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} \underline{637} \end{array}$$

$$\begin{array}{r} 4 \overline{)24} \\ \underline{6} \\ 6 \\ \underline{36} \\ 11 \\ \underline{396} \end{array}$$

$$\begin{array}{r} \underline{6} \\ 6 \\ \underline{36} \\ 11 \\ \underline{396} \end{array}$$

$$\begin{array}{r} \underline{36} \\ 11 \\ \underline{396} \end{array}$$

$$\begin{array}{r} \underline{11} \\ 396 \end{array}$$

$$\begin{array}{r} \underline{396} \end{array}$$

$$\begin{array}{r} \underline{396} \end{array}$$

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$$\begin{array}{r} \underline{396} \end{array}$$

$$\begin{array}{r} \underline{396} \end{array}$$

$$\begin{array}{r} \underline{396} \end{array}$$

144)21033(146.06 Feet, Answer.

$$\begin{array}{r} \underline{144} \end{array}$$

$$\begin{array}{r} \underline{663} \end{array}$$

$$\begin{array}{r} \underline{576} \end{array}$$

$$\begin{array}{r} \underline{873} \end{array}$$

$$\begin{array}{r} \underline{864} \end{array}$$

$$\begin{array}{r} \underline{900} \end{array}$$

$$\begin{array}{r} \underline{864} \end{array}$$

$$\begin{array}{r} \underline{36} \end{array}$$

The common way of girding round a tree, and taking the 4th part, does not give the full content of such tree, but only in proportion of about 4 to 5, or more nearly of 11 to 14. But though the error is known, the practice is continued, and with very good reason; for as such timber, till it is hewn, cannot be converted to any useful purposes, unless for pumps, pipes to convey water, or the like, it would be hard to charge for that which is unprofitable in general; and hence we have the best ground for continuing the custom. As this mode of measuring will give the content of the same timber when it is hewed for use, the only disadvantage to the buyer is that of carriage, and labour of hewing; but where the distance is great, is a matter of attention, it being settled by workmen and measurers, agreeable to the above proportion, that 40 feet of rough and unhewn timber shall be deemed a load, supposed to weigh a ton, or 20 cwt. but that 50 feet of hewn timber shall only be a load.

But perhaps the young student may be desirous of knowing the method for finding the full quantity of solid feet in any round tree or piece of timber, and therefore the following rule and example will be a necessary illustration.

Rule.] As all round timber must be tapering, multiply the girth at one end by the girth at the other; then subtract the circumference at the lesser end from the greater, square the difference, and divide it by 3, which add to the former. Multiply the sum by the decimal .0795, and the product by the length in feet, which divide by 144, and the quotient will be solid feet.

A a 3

Example.

THE YOUNG MAN'S

Example. A piece of timber is 136 inches in circumference at one end, and 32 at the other, the length being 21 feet; how many feet of timber does it contain?

$ \begin{array}{r} 136 \\ 32 \\ \hline 272 \\ 408 \\ \hline \text{Add } \left\{ \begin{array}{l} 4352 \\ 3605.33 \end{array} \right. \\ \hline 7957.33 \\ .0795 \\ \hline 3978665 \\ 7161597 \\ 5570131 \\ \hline 632.607735 \\ 21 \\ \hline 632607735 \\ 1265215470 \\ \hline \end{array} $	$ \begin{array}{r} 136 \\ 32 \\ \hline 104 \\ 104 \\ \hline 416 \\ 1040 \\ \hline 3)10816 \\ \hline 3605.33 \end{array} $
--	--

144)13284.762435(92.255 Feet, Answer
 1296....

$$\begin{array}{r}
 324 \\
 288 \\
 \hline
 367 \\
 288 \\
 \hline
 796 \\
 720 \\
 \hline
 762 \\
 720 \\
 \hline
 42 \\
 \hline
 \end{array}$$

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In like manner, we shall present the student with a rule for finding the content of a tapering square piece of timber, with an example to illustrate it.

Rule.] If the breadth and depth are equal at the respective ends, multiply the square of such breadth or depth, in inches, at one end, by the square at the other end, and extract the square root of such product; then add this root to the said squares, and multiply the sum by one third of the length in feet, dividing the product by 144, and the content will be had. Or if the breadth and depth are unequal, it is only to multiply the breadth by the depth, instead of squaring one of them, and proceed as before.

Example. A piece of timber is 32 inches broad, and 20 inches deep at one end, and 10 inches broad, and 6 inches deep at the other, and 18 feet in length; what is the content of that piece in solid feet?

32	640	} Add
20	60	
	195.95	
640		
60	895.95	
	6	
38400(195.95		
1	144)5375.70(37.33 Feet, Answ.	
	432	
29)284		
261	1055	
	1008	
385)2300		
1925	477	
	432	
3909)37500		
35181	450	
	432	
39185)231900		
195925	18	
35975		

But

But there is one thing more, which those who measure timber should not overlook, and that is, in making allowance for trees growing, or newly cut down, which have their bark on. For oak trees, it is usual to subtract one tenth, or one twelfth of the girth or circumference; but not so much for ash, elm, beech, &c. When this subtraction or allowance is made, then find the content with the rest, as before. Examples will be needless.

It has often been proposed as a puzzling question to scholars, how they will proceed to find the solid content of a faggot of brush-wood, furze, or the like; though that is of itself entirely useless, the method is of great use, and was successfully practised by *Archimedes*, in the matter of the crown which had been made for King *HIERO*, which is this: immerse the faggot, &c. in a regular vessel full of water, and the quantity which runs over will be equal to the content in inches, which divide by 1728, will give solid feet. Or, by putting the faggot, &c. in a regular empty vessel, whose content is or may be easily known, fill it up with water, and if the faggot is then taken out, and the empty part of the vessel is measured, the content may be also known.

Of CHRONOLOGY, and its Uses.

CHRONOLOGY is of the utmost utility in a course of education, but particularly in the study of history. Nothing within the compass of our own knowledge can be distinguished into its proper period of time, and much less any thing which relates to past ages, without at least a practical knowledge of this branch of science. In every age and country, the necessity of some mode of adjusting the particular occurrences of the times has been acknowledged; but in different nations, and amongst different people, different schemes have been invented or adopted; and sometimes, from remarkable circumstances, these schemes have been changed or altered, as occasions of-
ferred,

ferred, in the same countries. We usually distinguish the times from which these schemes are dated, or begin, by the name of an æra, or epocha.

To mention a few of the most common epochas in their order, the first is the Julian period. This is an imaginary point of time, instituted in the time of the dictator Julius Cæsar, and commences 705 years before the creation of the world: it is most useful, as including nearly all others. In this imaginary year, the cycle of indiction, the moon's metonic cycle, and the sun's cycle began together.

But though the Julian period goes so far back, the epocha of the creation is most ancient, and commences 4004 years before the birth of Christ, according to the best authorities; but the Greeks and eastern emperors, though with very little foundation, make the world of more ancient date. This was used by the Jews, who sometimes also reckoned from the flood, which was 2338 years before our Saviour.

The most ancient epocha among prophane authors is that of the olympiads, each containing 4 years; they began in the summer of 777 before the birth of our Saviour. Soon after this, viz. in 753, according to the Varronian account, or 752 by the Capitolian, the city of Rome was built, which became another epocha, or date of computation, and was only 24 or 25 years after the commencement of the olympiads. Again, the æra of Nabonassar, famous among astronomers, commenced in 747 before Christ, which was but 30 years later than the olympiads; but these years consisted only of 365 days each. Again, at the distance of 424 years from the preceding, or 324 years before our Saviour, was the death of *Alexander* the Great, which has been accounted by astronomers as an epocha.

But the most remarkable epocha among Christians, is that which commences from the reputed time of our Saviour's birth, which differs a little from the true time. All the others are generally reduced to this by historians and chronologers, to preserve order and uniformity. Others, as the *Abissines*, accounted from the

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the time of the *Disclesian* persecution, 284 years after Christ's birth, called the æra of the martyrs.

Another remarkable epocha, used by the Turks, Arabs, and others professing themselves to be the followers of *Mahomed*, is the *Hegira*, or Flight of *Mahomed*, which was in the year of Christ 622; but the Persians have an epocha 10 years later, in 632, which they call *Jesdegird*, the last Persian king of that name being then killed by the Saracens.

Our limits will not admit us to give a history of the different kinds of years, used as measures of computation in different ages of the world, by those who have reckoned by the epochas already mentioned. These were first guessed at by the motions of the sun and moon, and variously altered, as observation and experience seemed to require. *Julius Cæsar* was the first who brought the year to some degree of exactness, by instituting a solar year of 365 days and 6 hours; but it is probable that he learned this from the *Egyptians*, and thence rectified the Roman calendar, which before had been much corrupted. This account of time was observed by most nations, from that time, till the year 1582, when the Gregorian stile commenced; for as it had been found, by repeated observation, that the proper length of the year was 11 minutes 5 seconds less than the Julian year, and that the vernal equinox (when the days and nights are equal) had got back to March 11th, instead of the 21st, as observed at the Council of *Nice* in 325, the calendar was accordingly rectified, and measures taken to prevent any considerable errors in future. This was not adopted by the English till 1752, being 170 years after.

The Turks and Arabs were almost the only people who did not approve of the Julian calendar; they still persevere in the ancient way of computing by moons, notwithstanding the great reformation effected in other nations, to as great a degree of exactness as the nature of the thing will admit.

To return then to the Roman or Julian calendar, which we have adopted, it is of no importance to enquire why one month is longer than another, as the whole number of days in a year is commonly 365, but
in

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in every 4th year a day is added for the 6 hours in each year, which day is added to the short month of February.—See the Distich given at page 124, with the Divisions of Time mentioned in the preceding page.

If you want to find whether any particular year is a Leap-year, or a common one, note this verse,

Divide by 4, what's left shall be
For Leap-year 0, for past 1, 2, or 3.

Example 1. I desire to know if the year 1786 was a Leap-year or not?

$$\begin{array}{r}
 4 \overline{) 1786} (446 \\
 \underline{16 } \\
 18 \\
 \underline{16} \\
 26 \\
 \underline{24} \\
 2
 \end{array}$$

Note, That the two remaining shews the year 1786 to be the second after Leap-year.

Example 2. Was the year 1784 Leap-year or not?

$$\begin{array}{r}
 4 \overline{) 1784} (446 \\
 \underline{16 } \\
 18 \\
 \underline{16} \\
 24 \\
 \underline{24} \\
 0
 \end{array}$$

Note, That as there is no remainder, it shews that it was Leap-year.

As the seven first letters of the alphabet have been used to denote the 7 days of the week, the first of January being marked with A, the second with B, and so on, so as that the same letter shall stand against the same

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same day of the week throughout the year, whatever letter answers to the Sundays in any particular year is called the Dominical Letter, and in our almanacs is commonly printed with red. To find which, observe this diltich :

Divide the year, also its 4th, by 7,
What's left, subtract from 7, the letter's given.

That is, if 1 remains, then it is A, if 2, B, and so on.

Example 1. What is the Dominical Letter for the year 1786?

1786
446 the 4th Part.

7)2232(318
21

13
7
62
56
6

Then from 7
Take 6
Leaves 1

Note, That the 4th part of the year, rejecting the remainder, is added to the year, and the sum divided by 7, and the remainder after division being 6, and that subtracted from 7 leaves 1, or the letter A for the Dominical Letter.

Example 2. What is the Dominical Letter for the year 1784?

1784
446 the 4th Part.

7)2230(318
21

13
7
60
56
4

Then from 7
Take 4
Leaves 3

Note,

Note, That in every Leap-year, which you may always know, if you can take the 4th part without any remainder, there are two dominical letters, of which the number found by this rule, answering to the letter C, is the latter, and takes place after the 24th of February, when the additional day is supposed to be inserted into the calendar. For the first part of the year, the number 4 was the dominical number, and consequently D the dominical letter.

Next to these, we may take notice of the Solar Cycle, which is a period of 28 years, being one of the numbers upon which the Julian period is founded. All the varieties of the dominical letters will happen within this time, and every thing relating to it return in the same order, according to the Julian account; but according to the reformed calendar, it will be interrupted in the years 1800 and 1900, because they are only to be considered as common years, and not leap-years, as before in the Julian.

At the commencement of the Christian æra, the 9th year of this cycle was just completed, and from hence we have the following rule for finding it:

To th' year add 9, the sum if odd or even
Divide by 28, the cycle's given.

That is, the remainder is the number of the cycle, or if nothing, then 28 is the cycle.

Example. What was the cycle of the sun for 1786?

$$\begin{array}{r}
 1786 \\
 \text{Add} \quad 9 \\
 \hline
 28 \overline{) 1795} 64 \\
 \underline{168} \\
 115 \\
 \underline{112} \\
 3
 \end{array}$$

3 Answer.

Again, we must notice the Lunar Cycle, or Cycle of the Moon, which is a period of 19 years, and is another of the numbers on which the Julian period was founded.

ed. All the variations of days on which the new and full moons happen will occur within this time, and fall on the same days as they did 19 years before. This is frequently called the Metonic Cycle, from its inventor *Meton* the Athenian. But the new and full moons, which return on the same days, will happen 1 hour, 28 minutes, and 15 seconds sooner than each preceding; and as this was productive of much confusion, the reformed calendar rectified it. The years of this cycle were annexed to the old calendars throughout the year, and still continue for one month from the 21st of March, or the limits within which the full moon next before Easter is always found. As the first year of the Golden Number was just completed at the commencement of the Christian æra, the following rule for finding it naturally follows:

To the year, adding 1, if the sum you divide
By 19, the remainder the *Prime* will decide.

Note, That the year of this cycle is frequently called the *Prime*, and more commonly the *Golden Number*, because it was annexed to the old calendars in golden characters.

Example. What was the Golden Number for 1786?

$$\begin{array}{r}
 1786 \\
 \text{Add} \quad 1 \\
 \hline
 19 \overline{) 1787(94} \\
 \underline{171} \\
 77 \\
 \underline{76} \\
 1
 \end{array}$$

1 Answer.

Note, If nothing remains, then 19 is the Golden Number.

To these we may add the *Epact*, which is no other than the difference nearly between the number of days contained in a solar and lunar year; by which means it happens, that the *Epact* of any year is the moon's age

age on the first day of that year. In like manner, if we consider the difference of time from new moon to new moon to be 30 days, which it nearly is, the moon's age may be easily obtained for any day in the year, by knowing the Epact, which increases every year by 11, rejecting 30 when necessary. When the Golden Number is 1, the Epact is 0.

The Epact, when the Golden Number is given, is thus found :

From the Prime taking 1, if by 3 you divide,
And nothing remains, will your Epact decide,
For the said dividend; but for 1 left, add 10
To the same dividend, and your Epact's had then.

That is, if 1 remains, 10 must be added to the dividend for the Epact, and if 2, add 20; but if nothing remains, then the dividend, or 1 less than the Golden Number, is the Epact.

Example 1. What was the Epact for the year 1784, the Golden Number being 18?

Prime 18
Sub. 1

—
3)175
15

2 therefore add 20 to 17, which makes 37, and 30 being rejected, the Epact is 7.

Example 2. What was the Epact for 1786, the Golden Number being 1?

Prime 1
Sub. 1

—
0, therefore the Epact is 0, because as the dividend is a cypher, and so cannot be divided, consequently nothing is to be added to it for the Epact.

Having found the Epact for the year, the moon's age may be readily obtained; as by the following distich:

B b 2

Jan.

Jan. 0, Feb. 2, Mar. 1, Ap. 2, May 3,
 June 4, Jul. 5, Au. 6, Sep. 8. agree,
 Oc. 8, No. 10. De. 10, to Epact add
 And day, bate 30, Age or Change is had.

That is, to the Epact for the year, add the number annexed to each month, with the day of the month, and reject 30, if occasion, when the difference will be the moon's age, or very near it.

Example 1. What was the Moon's Age on the 1st of April 1784?

The Epact	7
No. for the Month	2
Day of the Month	1

The Moon's Age 10 or nearly so.

Example 2. What was the Moon's Age on the 23d of May 1786?

The Epact	0
No. for the Month	3
Day of the Month	23

The Moon's Age 26

In like manner you may easily find the time of the Moon's coming to the south, or the time when she appears highest in the heavens, by means of this distich.

The Moon's Age by 4, if by 5 you divide,
 The time of her Southing is nearly descry'd.

That is, 4 times the Moon's Age is to be divided by 5, and for every one remaining reckon 12 minutes, and the time from noon is obtained.

Example.

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Example. At what time on the 23d of May 1786 did the Moon come to the South?

The Moon's Age 26

Mult. 4

$$\begin{array}{r} 5 \overline{) 104} (20 \\ 10 \end{array}$$

4, or 20 hours, 48 minutes past noon, being 48 minutes past 8 o'clock of the following morning. But if you wish to know for that very morning, subtract 48 minutes, and that will leave 8 o'clock for the time of her southing.

To these rules, it may be useful to add the method of finding Easter, as a matter highly necessary in subjects of chronology, or the adjusting of historical facts to their proper periods of time.

Rule.] Having found the Epact for the year proposed, if it is 23 or less, subtract it from 44, and the remainder will be the limit of Easter, or the day of the Paschal full Moon; and if this limit or remainder exceeds 31, the full Moon is in *April*; but if 31, or less, in *March*, and the Sunday following is *Easter-Day*. But if the Epact is exactly 24, subtract it from 73; and if it exceeds 24, subtract it from 74. Again, if the Epact is 25, and the Golden Number is 12, or more, subtract it from 73; but not otherwise.

Example 1. What was the time of *Easter* in the year 1784?

As the Epact for 1784 is 7, subtract that from 44, and the remainder 37 is the Paschal limit, or day of full Moon; and if 31 be subtracted, it will leave 6, or the 6th of *April*, which being *Tuesday*, consequently the Sunday following, being the 11th of April, is *Easter* day for that year.

Example 2. When was Easter celebrated in the year 1783?

The Epact for that year being 26, is to be taken from 74, and the remainder 48, after 31 (the days in March)

B b 3

March) are deducted, will give April 17th for the limit of Easter, which in that year was *Thursday*; and therefore the *Sunday* following, or April 20th, was *Easter* day.

It only remains to take notice of the Roman Indiction, which is a period of 15 years, being the third number upon which the Julian period is founded. Of this Cycle 3 years were elapsed at the birth of Christ; and the knowledge of this is of great utility in adjusting the chronology of the Roman history. To find this, take the following rule:

To the year increase 3, and by 15 divide,
What leaves does the year of Indiction decide.

Example. What was the year of Roman Indiction for 1786?

$$\begin{array}{r}
 \text{The year} \quad 1786 \\
 \text{Add} \quad \quad \quad 3 \\
 \hline
 15 \overline{) 1789} (119 \\
 \underline{15 } \\
 28 \\
 \underline{15} \\
 139 \\
 \underline{135} \\
 4
 \end{array}$$

4 Answer; that is, 119 complete periods have elapsed since the birth of Christ, and the year 1786 is the 4th year of another period.

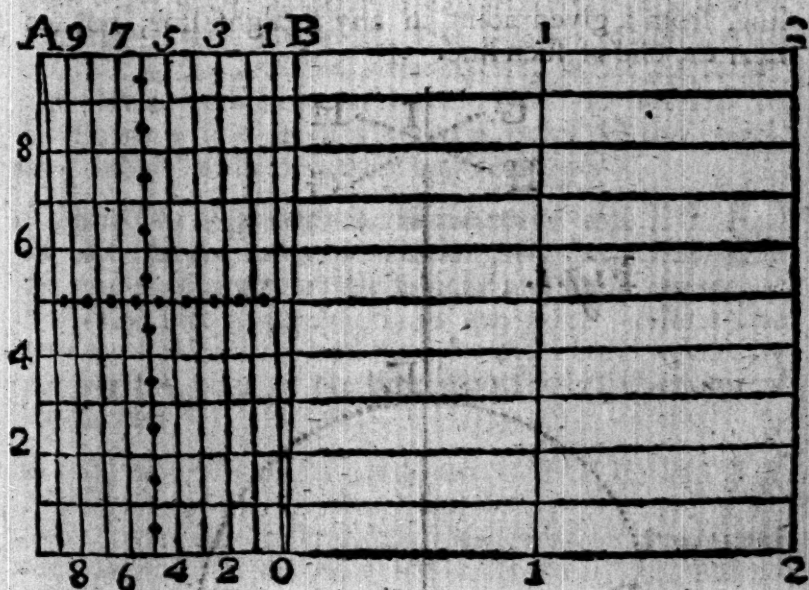
Of GEOMETRY, and its Uses.

WITHOUT a moderate knowledge at least of practical Geometry, in vain will the artificer, the mechanic, the architect, or any other artist, civil or military, pretend to judge of the nature and properties of things. But perhaps the principles generally necessary

necessary to a sufficient acquaintance with the practical uses to be made of it, may have been improperly extended; I shall therefore content myself with producing a few useful, practical problems, without which the artificer, mechanic, or artist, can never expect either to conceive a plan, or produce an estimate of any work of art.

Instruments of various kinds have been devised by men of science, for the readier performance of works of this nature; but the scale of equal parts and the line of chords are most commonly used. The method of forming both these, with the lines, tangents, secants, semi-tangents, shall be shewn as plainly as possible; for on these the operations in Geometry depend, and the several arts arising from thence.

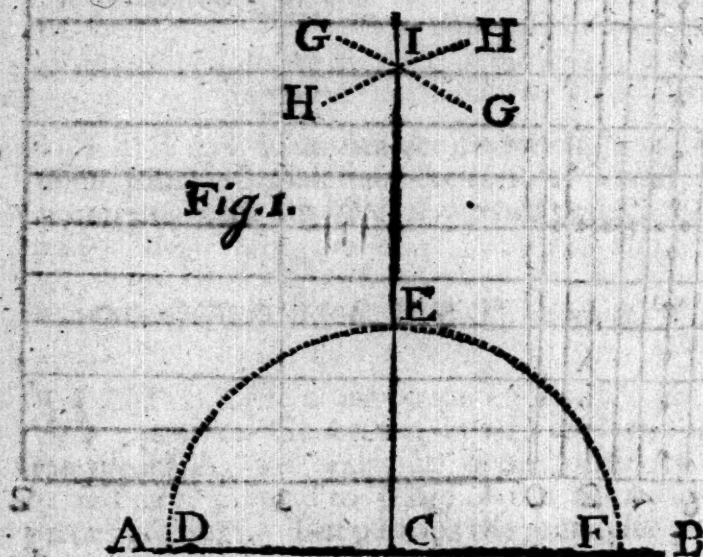
To make a scale of equal parts, suppose of 10 in an inch, first set off the length you propose it to be in inches, and draw a line from A to B, and parallel to that, and at equal distances from each other, draw 10 more lines, each of the same length, and join them at each end by another line, which will form it into a long square, as in the figure annexed. Then divide



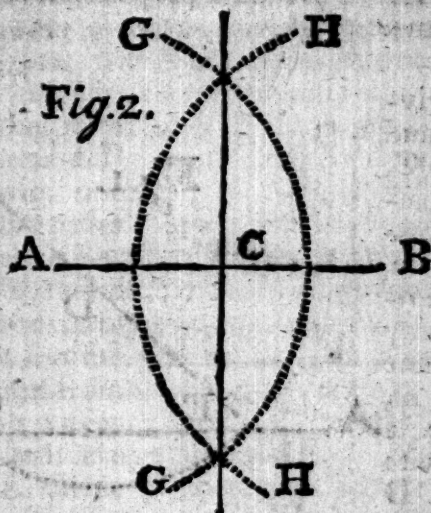
the

the whole line into inches, or divisions of 10 parts each, drawing lines directly across; divide the first inch into 10 parts, both in the highest and lowest line, and draw cross lines diagonally, so that they may cross from 0 to 1, from 1 to 2, &c. as in the figure, by which means each of those parts is subdivided into 10 parts more, by measuring on the different parallel lines for the units figure of the measure to be taken. The scale may be extended from B to the right-hand, to any required, or convenient length; and in like manner may any other scale be made to contain either more or less parts in an inch, and to any desired length, the most common extent being 9 of those large divisions, to be reckoned from B. And thus may those who cannot conveniently obtain instruments make such for themselves, only by means of compasses, as well as any other which are found on sectors, scales, &c. for the mathematical student's assistance; and the correctness of such lines may be ascertained, or any error discovered. But before I proceed to shew the method of making lines of chords, &c. it will be advisable to set the following problems before the reader.

PROBLEM I. To raise a perpendicular, or upright line, from a given point in any straight line, not too near the end of such line.



If



If the given line be AB , and the point at C , open the compasses to any convenient distance, suppose to D , and with one foot in C sweep the semicircular arch $DE F$, (or the two marks D and F will do.) Then open the compasses a little wider, as you see convenient, and with one foot in D , strike the little dotted arch GG with the other; and in like manner with one foot in F , and the same extent, strike the other little dotted arch HH , and these two will intersect in I . Draw a line from the given point C through I , which shall be the perpendicular required.

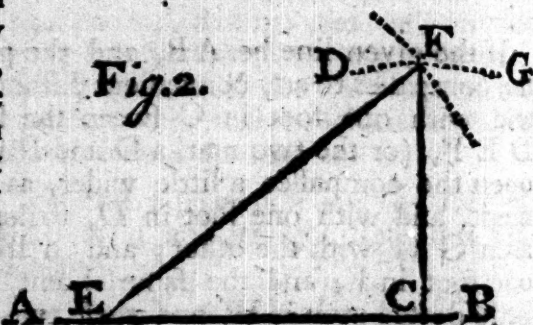
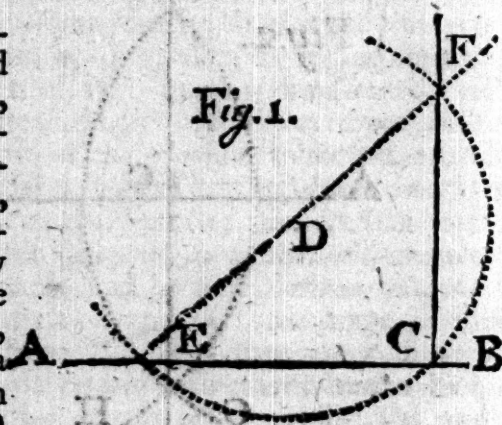
Note. By means of the semicircular arch $DE F$ of the first figure, a perpendicular may be raised upon the center of a circle; by which, and the diameter, it is divided into 4 quadrants, or 4th parts. Also a line may be divided into two parts by the second figure, by making the ends of the line respectively the center of the arches.

PROBLEM

PROBLEM II. To raise a perpendicular at or near the end of a line.

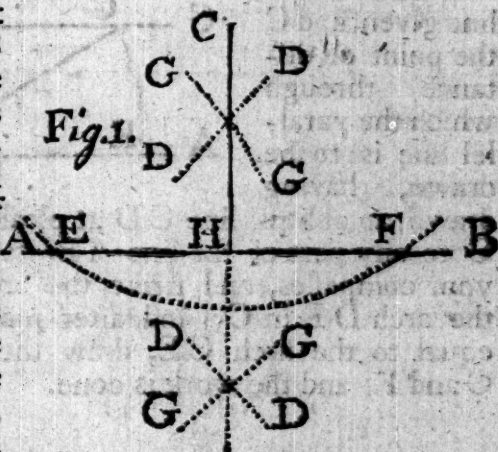
If the line given be AB , and the point at C , open the compasses to any convenient distance, and pitch the other foot any where above the line, as at D , which make a center, and with the distance CD sweep the arch ECF , and draw a line from E , where it cuts the line AB through D to meet that arch in F ; draw CF , which shall be the required perpendicular.—

Or, take off from a scale of equal parts the number 4, or 40, in your compasses, from the point C towards A , which will extend to E , and with 3 or 30 taken from the same scale, and one foot in C , sweep the little arch DG , and with 5 or 50, and one foot in E , extend it to meet the other arch in F , and through that and C draw a line for the perpendicular, and if the two points E and F were joined, it would be a right angled triangle.

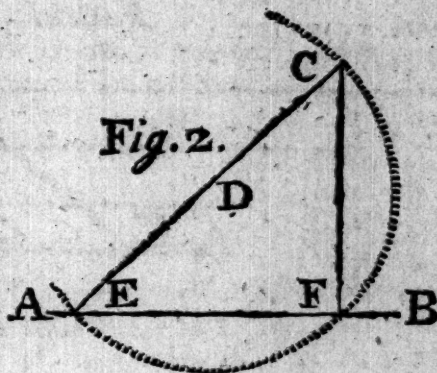


PROBLEM III. To let fall a perpendicular from any given point to any given right line at a convenient distance from it.

If the given point be at C, and A B the line, with one foot of the compasses in C, the other being extended beyond the nearest point of the line, sweep the arch E F, and from F, with any radius more than half the distance F E, strike the small arch D D, and do the same in E for the arch G G, either above or below the line A B, and through these intersections draw C H for the perpendicular required.



Or, if from the given point C, a line be drawn in any direction to cross the line given, as at E, if the distance C E

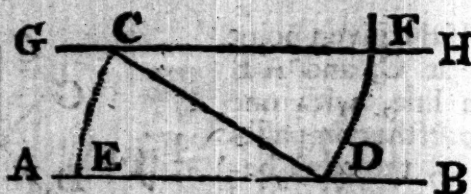


be divided into two parts in the point D, as by Prob. I. set one foot of the compasses in D, opening the other to the point C, and describe the arch C F E; then draw C F, where the arch cuts A B, and the perpendicular is obtained, as in Fig. II.

PROBLEM

PROBLEM IV. To draw a right line parallel to another given right line, at any assigned distance.

If AB be the line given, and C the point of distance through which the parallel line is to be drawn, having

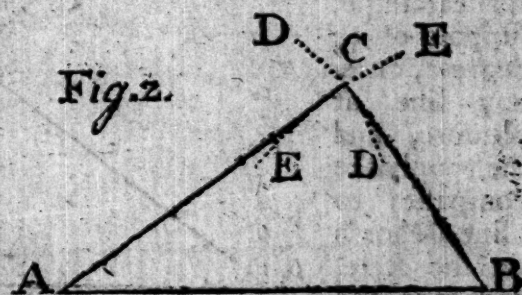
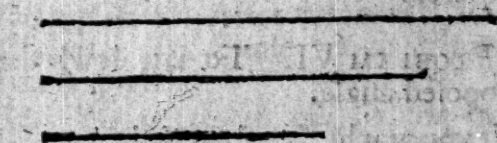
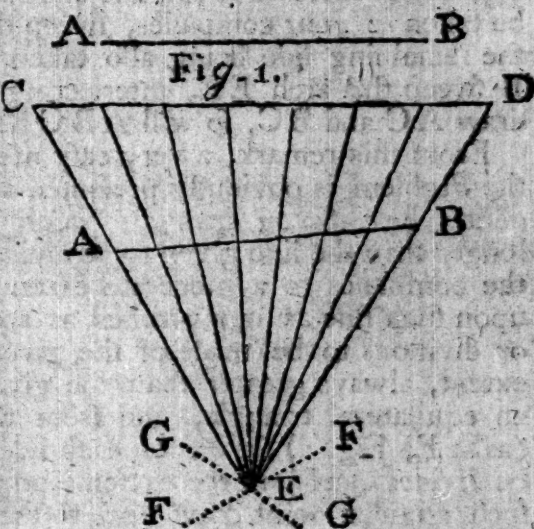


drawn an oblique line CD at pleasure, from the point C to any part of the line AB , take that distance in your compasses, and strike the arch CE in D , and the arch DF in C ; and after making the arch DF equal to the arch CE , draw the line GH through C and F , and the work is done.

PROBLEM

PROBLEM V. To divide a right line into any number of equal parts.

If the line AB is given to be divided into 7 equal parts, take the number 7 from any scale of equal parts longer than the given line in your compasses, suppose CD , and mark the divisions accordingly; then take the line CD , and with one foot in C , sweep the arch FF , and again with one foot in D sweep the other arch GG , which will intersect each other in E ; and having joined CE and DE , take the given line AB in your compasses, moving the points so that it may be parallel to CD , its ends being in the lines CE and DE , which



join; then draw lines from the division marks in CD , through AB , to E , and thus will it be divided into so many equal parts.

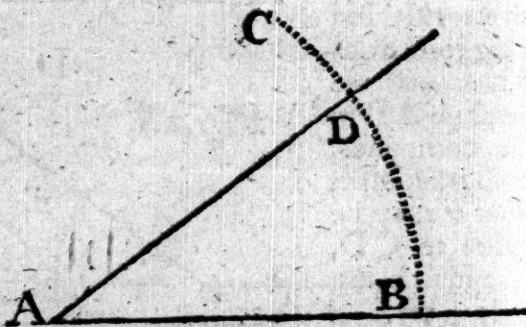
Note, CDE being joined, will make an equilateral triangle; and thus, if one side be given, any other equal-sided triangle may be drawn. Any other triangle

angle may also be drawn after the same manner, the three sides being given; for if any side, as AB in Fig. II. be first laid down, and one of the sides, as AC , be taken in your compasses, sweep the arch DD , and the remaining side being also taken, with one foot in B sweep the arch EE , intersecting each other in C , draw AC and BC , so will ABC be the triangle.

From this remark, a very easy method of resolving the Problem is obviously presented to the young student. For if you draw an occult line considerably longer than the line given to be divided, and, opening the compasses to a moderate extent, turn them over upon such line as many times as are the equal parts or divisions to be made of the given line; with this extent, always greater than the given line, construct an equilateral triangle, and from the angular point (as at E , Fig. 1) set off on each side the given line to be divided, and join the extreme points. Then from such angular point draw lines to the several divisions in the side opposite, which shall cut the given line as required.

PROBLEM VI. To lay down the quantity of any proposed angle.

If you would make an angle, suppose of 35 degrees, draw any line at pleasure, and then apply the compasses to a line of chords on the scale, and take the

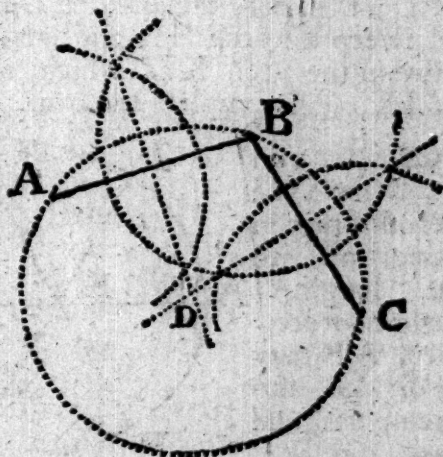


distance exactly from the beginning to 60, and with one foot in the end of the line drawn, as at A , sweep the arch BC , and from the same line of chords take 35, which set off on the arch from B to D . Then, by drawing a line from A through D , an angle of 35 degrees will be formed at A . In this manner may the measure of any angle be taken.

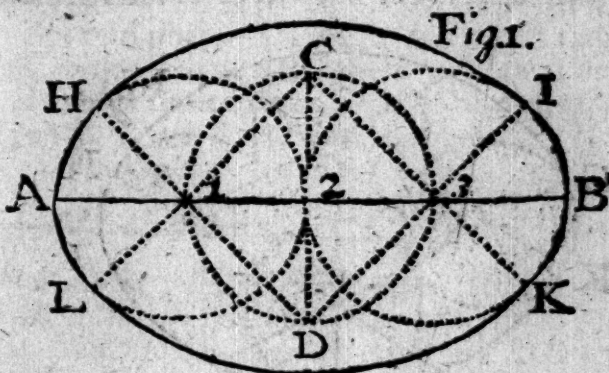
PROBLEM

PROBLEM VII. To find the center of a circle which shall be equally distant from any three given points, not in a right line, and through which, with that distance as a radius, the circumference of such circle may be drawn.

If A, B, and C, be the three given points, bisect the distance AB, and also the distance BC, as by Problem I. Fig. 2. and draw lines inward, till they intersect each other in D, which will be the center required; then with the distance DA, DB, or DC, (for they are all equal) draw the circle required to pass through all the given points. After the same manner may be found the center of a circle which will circumscribe any given triangle.



PROBLEM VIII. To make an ellipsis, or oval, either by having the longest diameter given only, or the shortest only, or both.



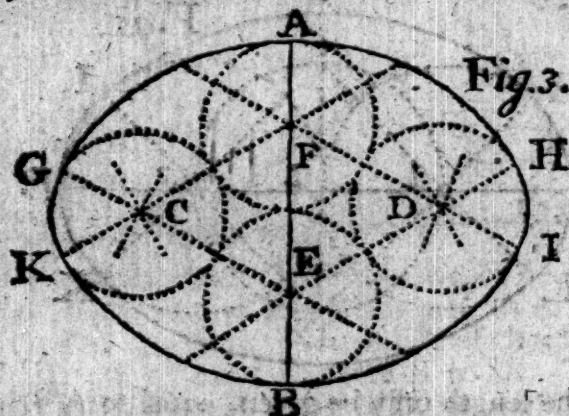
r. If the length only be given, equal to AB, divide the said line into four parts, and thereon draw three small

small circles on the divisions 1, 2, and 3, as centers, on the middle of which raise a perpendicular; and from C and D, where it reaches the circumference of the middle circle, draw lines through the centers of the two outermost circles, to their extremes in H, I, K, and L; then take the distance DH in your compasses, and sweep the arch HI, and with the same radius in C sweep the arch KL, which, with the arches HL and IK, will complete the oval.

Or, if you would have the breadth fuller in proportion to the length, though not confined, AB may be divided into three parts, and two circles drawn upon it;

and from the intersecting points C and D, through the centers E and F, draw lines to G and H, and to I and K; and with the distance CG in your compasses, sweep the arch GH, and with the same radius in D describe IK, to finish the oval.

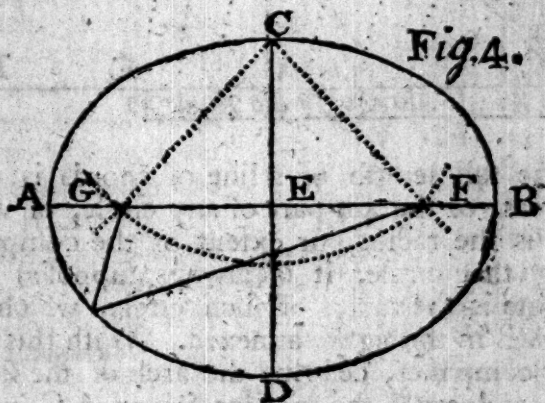
2. If the breadth only be given, draw two small circles, with a radius of one fourth of such breadth, so



that their circumference may just touch each other, and

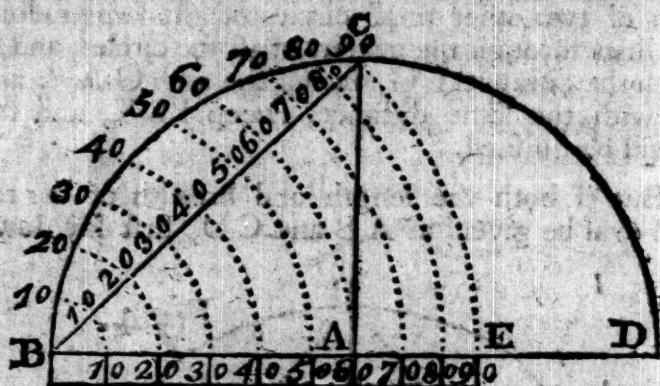
and with the distance of their centers, and with one foot of the compasses in each center, strike the little arches to intersect each other in C and D, which shall be the centers of two other small circles of the same radius. Draw lines through the centers of all the circles, and in E, with the distance E G, sweep the arch G A H, and in F, with the same distance, sweep I B K, and the oval will be finished.

3. But if both the length and breadth of the required oval be given, as A B and C D, first lay down.



A B, and bisect it in E, setting off the half of the given breadth each way from E, to C and D; take A E, viz. half A B, in your compasses, and with one foot in C or D sweep the arch F G, to cut the line A B in F and G. Fix two pins at F and G, and round them a silk thread, which may reach from F to C, and thence to G; if this be turned round a moveable pin, or a black-lead pencil, it will describe an exact oval.

PROBLEM IX. To make a line of chords, by the compasses alone, to any length required; suppose AB,

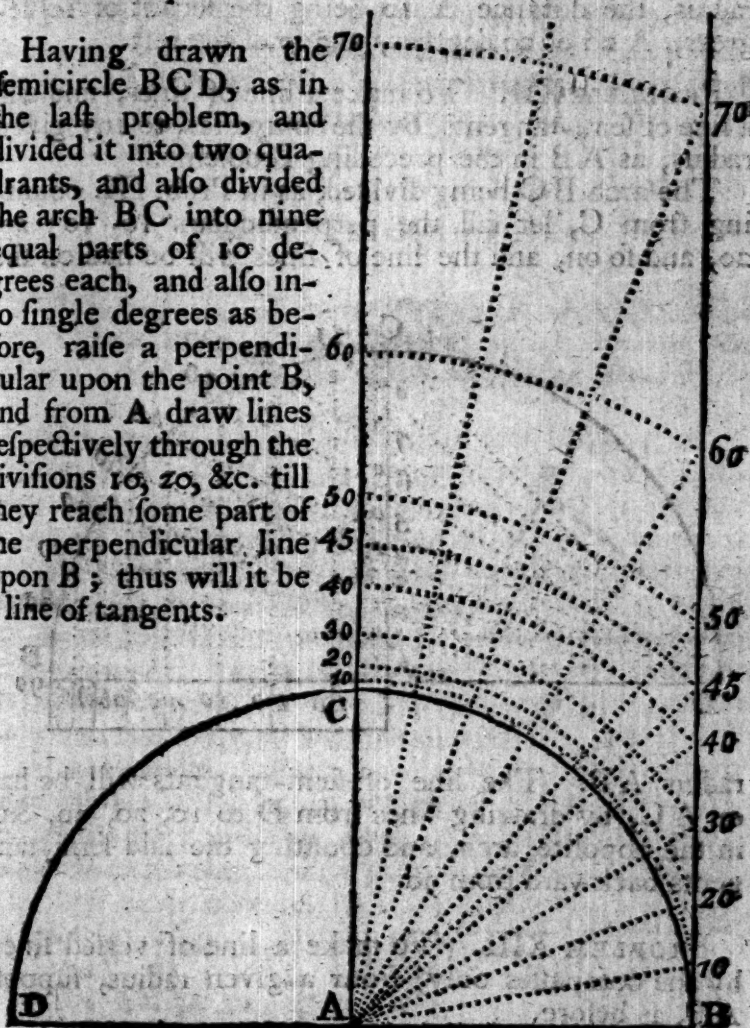


As the full length of a line of chords is equal to 90 degrees, or the 4th part of any circle, of which 60 degrees is the radius, or extent of the compasses for drawing that circle, it is always supposed that the given line is the radius of such circle, which in this case is AB in the figure annexed. With this distance in your compasses, describe the arch of the semicircle BCD, and erect the perpendicular AC upon the center, first drawing DB through A to complete the semicircle. Then divide the arch BC into nine equal parts of 10 degrees each, and each of these into 10 parts, or single degrees, and upon B as a center, with the several distances, B 10, B 20, &c. sweep the arches as in the figure, and the line BC, or BE, shall be the line of chords required.

Note, That every circle is supposed to be divided into 360 equal parts, as the globe of the earth is, and each quarter is consequently 90 degrees, and the radius, or half diameter, is always 60; and each degree is supposed again to be divided into 60 equal parts, called minutes.

PROBLEM X. To make a line of tangents, by the compasses only, to any radius required; suppose AB , as in the last problem.

Having drawn the femicircle BCD , as in the last problem, and divided it into two quadrants, and also divided the arch BC into nine equal parts of 10 degrees each, and also into single degrees as before, raise a perpendicular upon the point B , and from A draw lines respectively through the divisions $10, 20, \&c.$ till they reach some part of the perpendicular line upon B ; thus will it be a line of tangents.



PROBLEM XI. To make a line of secants, by the compasses alone, to any radius, suppose AB , as before.

The line of tangents being had, as in the last problem, continue the perpendicular AC at pleasure; then with one foot of the compasses in A , extend the other

line DAB be the versed line of 180 degrees to the radius AB.

Thus the several lines are obtained, usually put upon plain scales, or sectors, which are of the greatest use in every branch of practical Mathematics. And thus much may suffice for the Geometrical part; we shall now proceed to Trigonometry.

Of PLAIN TRIGONOMETRY.

THE doctrine of Plain Triangles, which constitutes Plain Trigonometry, is of the utmost utility. A plain triangle then consists of three straight sides, as Fig. 1, 2, 3, 4, or 5, all of which are plain triangles, consisting of three sides and three angles, of which Fig. 1 is also called an oblique triangle, and hath all its sides unequal. In like manner Fig. 2 hath all its sides equal, and is called an equilateral triangle. Fig. 3 hath two of its sides equal, the third being greater or less, and is called an isosceles triangle. Fig. 4 is a right angled triangle, in which two of its sides must be perpendicular to each other at their junction, and may have all its sides unequal, as Fig. 1, or the two legs equal, as Fig. 3, but can never be similar to Fig. 2; also Fig. 5 is an obtuse angled triangle, the largest angle being greater than that of Fig. 4, or more than 90 degrees, as a right angled triangle is always equal to it. An acute angle is less than 90 degrees.

Fig. 1.

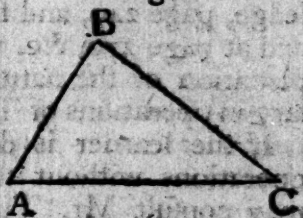


Fig. 2.

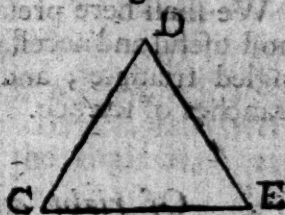


Fig. 3.



It

It must be noted, that the three angles of every plain triangle are equal to two right angles; that is, to twice 90, or 180 degrees; so that if two of the angles are known, the third is known by subtracting the sum of the other two. The quantity of any angle is obtained by Prob. VI. of Geometry; and other particulars, too numerous to be

observed here, may be known under the heads of Geometry and Trigonometry, in the last edition of Mr. Fenning's Young Man's Book of Knowledge, page 240, and forwards, and at page 270, &c. will also be found a sufficient explanation of the nature of Logarithms, highly necessary in operations of Trigonometry, Navigation, &c.

If the learner is desirous of performing the same operations without the assistance of Logarithms, he may consult Mr. Turner's Treatise of Plain Trigonometry, to be had of the publishers of this Work.

We shall here present the reader with a few of the most useful and necessary Problems in right and oblique-angled triangles, and then pass on to the dependent branches of science.

Of right angled Plain Triangles.

To resolve any Problem relating to right-angled triangles, it is necessary, besides the right angle, to have two sides given, or an angle and a side, to find the rest; for as every triangle consists of three sides and three angles, one half must be given to find the other, in which one side must always be given, and the right angle, or 90 degrees, is always given. The sides of every plain triangle are in proportion to the sines of their opposite angles.

Fig. 4.

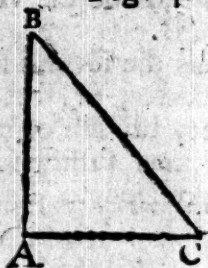
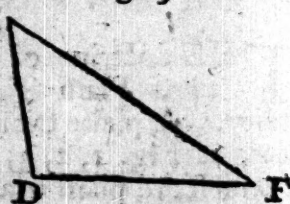


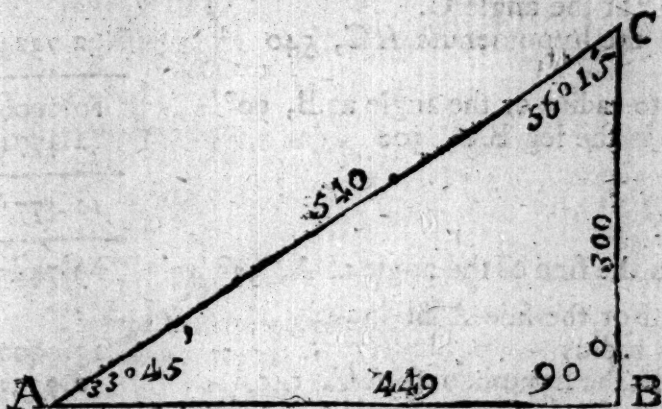
Fig. 5.



PROBLEM

UNIVERSAL COMPANION. 299

PROBLEM I. Given the side AB , and the hypotenuse AC , of the right-angled triangle ABC , to find BC , and also the angles at A and C .



1. To find the angle C .

As the hypotenuse AC , 540

2.732394

Is to radius, or the angle at B , 90°

10.000000

So is the leg or side AB , 449

2.652246

12.652246

To the fine of the angle at C , $56^\circ 15'$ 9.919852

Note, That the complement of one of the acute angles to 90° , is equal to the other acute angle of every right-angled triangle; therefore the angle at A will be $33^\circ 45'$

2. To find the side BC .

As radius, or the angle at B ,

10.000000

Is to AC , its opposite side, 540

2.732394

So is the fine of the angle at A , $33^\circ 45'$

9.744739

To the leg or side BC , 300

2.477133

Note, That when the first term is radius, or the logarithm fine of 90° , the operation may be easily found by Addition, only leaving out 10 in the index.

PROBLEM

300 THE YOUNG MAN'S

PROBLEM II. Given the hypotenuse AC as before, and the leg or side BC 300, to find the other leg AB, and the angles A and C.

1. For the angle C.

As the hypotenuse AC, 540

2.732394

Is to radius or the angle at B, 90°

10.000000

So is the leg BC, 300

2.477121

12.477121

To the sine of the angle at A, $33^\circ 45'$

9.744727

2. For the side AB.

As radius

10.000000

Is to the hypotenuse AC, 540

2.732394

So is the sine of the angle C, $56^\circ 15'$

9.919846

To the side AB, 449

2.652240

PROBLEM III. Given the two legs AB and BC, as before, to find the hypotenuse AC, and the angles at A and C.

1. For the angle at A.

As the side AB, 449

2.652246

Is to radius

10.000000

So is the side BC, 300

2.477121

12.477121

To the tangent of the angle A, $33^\circ 45'$

9.824875

2. For the hypotenuse AC.

As the sine of the angle A, $33^\circ 45'$

9.744739

Is to the side BC, 300

2.477121

So is radius, or sine of 90°

10.000000

12.477121

To the hypotenuse AC, 540

2.732382

PROBLEM

UNIVERSAL COMPANION. 301

PROBLEM IV. Given one of the acute angles, suppose C, as before, and the leg AB, to find the other leg BC, and the hypotenuse AC.

1. To find BC.

As the sine of the angle C, $56^{\circ} 15'$ 9.919846

Is to AB, 449

2.652246

So is the sine of the angle A, $33^{\circ} 45'$ 9.744739

12.396985

To BC, 300

2.477139

2. To find the hypotenuse AC.

As the sine of the angle C, $56^{\circ} 15'$ 9.919846

Is to the side AB, 449

2.652246

So is radius, or the sine of 90° 10.000000

12.652246

To the hypotenuse AC, 540

2.732400

PROBLEM V. Given one of the acute angles, suppose C, as before, with the hypotenuse AC, to find the two legs.

1. To find AB.

As radius

10.000000

Is to the hypotenuse AC, 540

2.732394

So is the sine of the angle C, $56^{\circ} 15'$ 9.919846

To the leg or side AB, 449

2.652240

2. To find the perpendicular BC.

As radius

10.000000

Is to the hypotenuse AC, 540

2.732394

So is the sine of the angle A, $33^{\circ} 45'$ 9.744739

To the perpendicular BC, 300

2.477133

D d

Thes:

These Problems, with their operations, will be abundantly sufficient for all the common purposes of Navigation, Astronomy, Dialling, &c. so far as they depend upon Plain Trigonometry; but because we have one useful Problem for finding the third side of a right-angled triangle, when two of the sides are given, without finding the acute angles, and as it is an exemplification of the Square-Root, to which reference has been made, it is here added.

PROBLEM VI. Given two of the sides of a right-angled triangle, to find the third side.

Rule. If both the legs are given, square them singly, and extract the Square-Root of their sum for the hypotenuse; but if the hypotenuse be given, and one of the legs, square them singly, and extract the Square-Root of their difference for the other leg.

Example 1. If the height of any fort or tower is known to be 40 feet, and the breadth of a moat, foss, or ditch in front of it is 30 feet; of what length must be a ladder to reach from the opposite bank to the top of the tower?

	40	30
	40	30
	1600	900
Add	900	
	2500	(50 Answer.
	25	
	100)	00

Example

Example 2. If the height of the tower and length of the ladder be known, to find the breadth of the ditch.

$$\begin{array}{r}
 40 \\
 \hline
 40 \\
 1600
 \end{array}
 \qquad
 \begin{array}{r}
 50 \\
 \hline
 50 \\
 2500 \\
 1600 \text{ Sub.} \\
 \hline
 900(30 \text{ Feet, Answ.} \\
 9 \cdot \\
 \hline
 60)00
 \end{array}$$

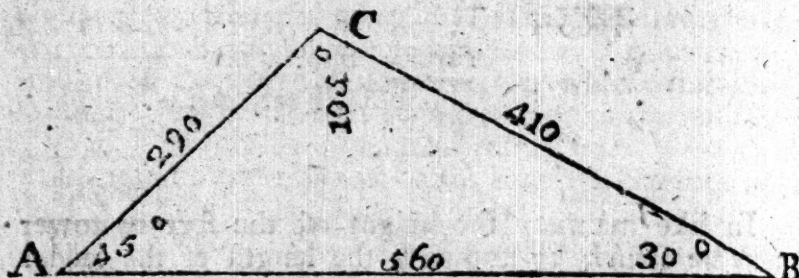
In like manner, the height of the fort or tower may be found, by knowing the length of the ladder and breadth of the foss.

The distance of any place may also be found, though you cannot measure it, in the following manner: having fixed your first station, and directed your eye to any certain point of your object, move backwards or forwards, at right angles, to the line pointing out such object, till you can see the object and your first station making an angle of 45° ; and then the distance of those stations will be equal to the distance from the first station to the object. But if you cannot see the object with that angle, take the quantity of any other angle, which, by measuring the distance of the two stations, and proceeding as under Problem IV. will give the distance of your first station from the object.

Of oblique-angled Plain Triangles.

For resolving any Problem in an oblique-angled plain triangle, three things must always be known to find the other three; but one or more sides must be given, though it is not always necessary for an angle to be known. If any one angle is obtuse, or more than 90° , take the supplement of it to 180 in the operation.

PROBLEM I. Given one side AB of the oblique-angled triangle ABC equal to 560, with the angle at A 45° , and the angle at B 30° , to find the sides AC and BC .



1. For the side AC .

As the S. of the angle C , 105° or 75°

9.984944

Is to its opposite side AB , 560

2.748188

So is the S. of the angle B , 30°

9.698970

12.447158

To the side AC , 290

2.462214

Note, That as the three angles of every plain triangle, whether right angled or oblique, are equal to 180° ; consequently as the angles A and B are both equal to 75° , the angle C must be 105° , and its complement to 180 equal to 75° .

2. For the side BC .

As the S. of the angle C , 105° or 75°

9.981944

Is to its opposite side AB , 560

2.748188

So is the S. of the angle A , 45°

9.849485

12.597673

To the side BC , 410

2.612729

PROBLEM

UNIVERSAL COMPANION. 305

PROBLEM II. Given the sides AC and BC of the triangle ABC, with the angle A, opposite to BC, to find the angles B and C, and the side AB.

1. For the angle B.

As the side BC, 410 2.612784

Is to the S. of its opposite angle A, 45° 9.849485

So is the side AC, 290 2.462398

12.311883

To its opposite angle B, 30° 9.699099

Note, That the sum of the angles A and B being 75° , the complement to 180 or 105° must be the third angle, or the angle at C.

2. For the side AB.

As the S. of the angle A, 45° 9.849485

Is to the side BC, 410 2.612784

So is the S. of the angle C, 105° or 75° 9.984944

12.597728

To the side AB, 560 2.748243

PROBLEM III. Given the sides AC and BC, with the angle C included, to find the angles A and B and the side AB.

To find the angles.

As the sum of the two sides AC and BC, } 2.845098
700

Is to their difference, 120 2.079181

So is the tangent of half the sum of the } 9.884980
angles required, or $37^\circ 30'$

11.964161

To the tangent of half their difference, } 9.119063,
 $7^\circ 30'$

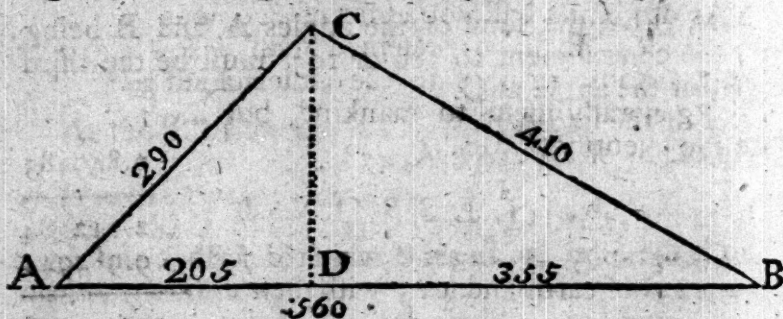
which being subtracted from the half sum, will leave 30° for the lesser angle; and as the side AC is least,

is consequently the measure of its opposite angle B. Add this to the angle C, and the sum taken from 180 will leave 45° for the angle A.

Note, That the least angle should always be found first; because if either of the angles required is obtuse, the sum of these two taken from 180 will leave the greater of the angles required, without the possibility of mistake.

Having found the angles, the side AB may be found by the preceding Problem.

PROBLEM IV. Given the three sides of an oblique angled plain triangle, to find any of the angles.



It will be necessary to divide the greatest side AB into two parts, by a perpendicular CD let fall from C, and then you will have two right-angled triangles ACD and BCD, with which proceed thus:

As the side AB, 560

2.748188

Is to the sum of the other two sides, 700

2.845098

So is their difference, 120

2.079181

4.924279

To the difference of the segments of the base, 150

2.176091

If this be subtracted from 560, the whole base, half the remainder will be 205, or the segment AD. Also if it be added to 560, half the sum will be 355, equal to DB. Then you will have two right-angled plain triangles, of which the base and hypotenuse are given,

to

to find the angle A or B, and consequently the angle C, by Problem II. of right-angled plain triangles already given.

Of GEOGRAPHY.

THE next thing in order, advisable to be known previous to Astronomy and Navigation, is Geography; an art or science (for it certainly deserves that appellation, though not one of the seven liberal sciences) of great importance to the due knowledge of those dependant branches of Trigonometry.

As our limits will not admit of a copious illustration, the student shall be presented with a few short and plain lessons, relative to the understanding of maps, &c. generally useful to mankind, but more especially to the scientific.

LESSON I.

Geography is an art * which describes the several varieties of earth and seas, with their different positions and situations. These several phases or appearances constitute the surface of the globe which we inhabit.

The knowledge of these is what we commonly understand when we speak of Geography as an art or science. To attain this knowledge must be very desirable, and many helps and assistances have been devised for that purpose; but amongst the principal and most beneficial, maps and charts are most easy and natural. With the same view have artificial globes and spheres been invented; but at present I shall confine my observations to maps.

* Geography is here stiled an *Art*, in compliance with the received authority of the times. It has of late obtained amongst mathematicians to exclude all attainments in mathematical and other knowledge from the character of a science, but those SEVEN which have acquired the name of *liberal*. But I shall consider it as an art or science indifferently; for surely, if GEOMETRY, which only consists in measuring the earth, strictly understood, is entitled to the name of *liberal*, the description may justly be entitled to the character.

Maps

Maps, then, are designed to point out by inspection the distance and situation of different countries and kingdoms, or of different divisions, districts, or places in the same countries or kingdoms. Charts in like manner are used to point out the same things upon the seas, or the situation of different ports on the sea coast; and serve to shew the distance of ports from each other, either on the coasts of the same kingdom, or those of greater distance.

All maps and charts should be so laid down, that the northern countries or places may appear towards the top, and places and countries southward towards the bottom of your paper or draught; and consequently such as lay eastward must be situated on the right-hand, and those westward on the left.

In all cases where maps and charts are not laid down exactly in this manner, a circular figure, representing a compass, having a fleur-de-lis to point out the true northerly direction, is always placed in some vacant part of all modern maps. Those which are truly drawn, (agreeable to the general method) are sometimes decorated with one or more of these compasses so supplied.

LESSON II.

All places which lay in a line exactly east and west of each other, are said to be in the same latitude, and those which are exactly north and south, in the same longitude.

Latitude is the distance of any place from an imaginary circle which is supposed to surround the earth and seas, called the Equator, and is south or north according to its direction from that circle. The Equator, sometimes called *The Equinoctial Line*, and by seamen simply *The Line*, is in the highest part of the globe, and equally distant from two points on its surface, called the North and South Poles, on which, as an axis, the earth turns round every 24 hours; which rotation occasions those different appearances of rising and setting of the sun, daily experienced by all the inhabitants

habitants between the Tropics*. Longitude is the distance of any place from another given place, whether east or west.

All places, therefore, which do not lay directly north and south, differ from each other in longitude, as those which are not in a line directly east and west differ in latitude; consequently those which are not exactly situated from each other in either direction, differ in both.

Places which are exactly north and south are said to lie on the same meridian, because they have mid-day, or 12 o'clock, at the same time; but there are as many different meridians as there are places in the world differing in longitude, every point having its proper meridian, the two poles only excepted, where all those meridians unite as a center.

Maps are to be recommended as the readiest method of learning Geography; their utility at least cannot be denied. These are generally delineated for some particular meridian; and such as are printed for England, Scotland, Ireland, or the British isles, commonly reckon the longitude from London, or that line which is supposed when drawn from pole to pole to pass through London. Most foreign maps, particularly those printed for France, or other parts of the continent of Europe, and in general for the four quarters of the world, have their first meridian drawn through Ferro, the most westerly island of the Canaries. Maps of the world, especially such as are projected in two hemispheres on the plane of the general meridian, are mostly drawn in this manner; and by this method the three quarters of Europe, Asia, and Africa, are entirely comprehended in one of them, and that of America in the other.—So much for the outlines.

LESSON III.

In proceeding to the particulars, it must be observed, that the latitude of places is mostly marked in degrees

* What the tropics are, with other imaginary circles, not here explained, may be seen in Mr. Fenning's Young Man's Book of Knowledge, and his Use of the Globes. For a general knowledge of maps, the present description will be sufficient.

and

and minutes on the west and east sides of our maps, as the longitude is on the north and south limits; but this is sometimes given in hours and minutes of time, to shew the difference of time in which the sun appears respectively on the meridians of those places. In maps of counties, or small districts of countries, which include only a small compass, a scale * is frequently introduced to shew the distance of places in miles, &c. and the marginal references are sometimes omitted.

The distance from the equator to the poles is divided into 90 degrees, and each degree is subdivided into 60 minutes, or geographical miles, each being nearly one sixth more than an English statute mile. By this division, the whole circle of the globe contains 360 degrees, into which every circle is supposed to be divided; and the situation of places betwixt the equator and the poles, each way, is determined by the degrees and minutes of distance from the part of the equator nearest such place, being that which lies on the same meridian. This is what distinguishes the latitude. The longitude is divided each way from some particular meridian, for which the map is constructed, into 180 degrees east or west; but these degrees are very unequal, for although at the equator they are the same as those of the latitude, they gradually decrease towards each pole, where the different meridian lines terminate, and where consequently there is no such thing as longitude. Hence it is, that in large maps, which include a considerable extent of earth or sea, the parallels of latitude and longitude, generally drawn through every 10 degrees, always appear curvilinear, as they are described on globes.

We are next to consider the situation of remarkable places, with their bearing and distance from each other. For this purpose, the nature of provincial maps, or maps of counties and small districts, should be fully un-

* When this scale is omitted, as may frequently be the case in provincial maps, or maps of counties, travelling pocket maps, &c. the deficiency is supplied commonly by laying down the distances in the body of such maps regularly between the several towns or places of note. Many of our maps of England have been printed in this manner.

derstood;

derstood; the latitude of the principal city or town it contains should be exactly known as the basis or foundation, and its longitude, if any, from some known customary meridian. Having then considered the bearing and distance of any other cities, boroughs, or market towns therein contained, it will be easy to find the particular situation of any smaller town or village, and the exact place of the map on which it is or ought to be delineated. And thus much may suffice for the nature of small maps.

LESSON IV.

In treating of larger maps, we shall begin with those which only extend to any one particular state or kingdom. The first object, as before in provincial maps, is to find out the principal city or town in each district, division, or county, and the situation and extent of each particular district.

To illustrate this, let the counties of England supply the student with suitable observations. The latitude of London, the metropolis of the kingdom, being known, and the first meridian being supposed to pass through it, from which the longitude is to be reckoned, consider the situation of the several counties; those upon the sea coast are the first which should merit our notice, with their bearing and distance from the capital of the kingdom. The extent of each in length and breadth should be attended to, with the counties bordering upon them, whether coast-ways or inland, and on what side they are situated. Inland counties, which are separated from the sea, should be compared with the counties that surround them; and the distance of the several cities or county towns from each other, with their relative situation, should be observed. By considering the situation of the several counties bordering on the capital or metropolis of the kingdom after the same manner, the general state of all the counties in the kingdom will be attained.

These observations must be equally true in examining the maps of any other kingdom or state. The same method must be pursued in order to a general knowledge of the nature of such kingdom or state. No person

person can be at a loss to understand the maps of any kingdom or country, after paying a due attention to these remarks; and the several districts and divisions into which such country is divided, must in like manner be as certainly known.

Dissection of maps * has been much recommended, as of singular advantage towards attaining a proper knowledge of their nature and use. A few general remarks may be made on this species or mode of instruction, as tending to facilitate the knowledge of maps.

All maps are or ought to be so constructed, that, when divided into fragments or parcels, the names of places may for the most part appear in a proper position, when the most northerly places are towards the top, or at the farthest distance from the eye. Hence the position of the several parts will become obvious from the preceding observations. Some particular place should be here noticed also as the basis of the rest, and the center, as it were, of every other less distinguished town or village, from whence the respective direction must be made. Thus will every distinct part adjoining be necessarily and unavoidably evident, and the knowledge of the situation of any remarkable city, town, or village must be certain; the student is thus naturally directed in the attainment of useful knowledge, and insensibly surprized into an acquaintance with that which presented at a distance the most unfriendly and forbidding aspect. The same method, if regularly pursued through each division, province, or district, will readily direct to the use of the most com-

* Dissection of small maps, as those of counties into their several hundreds, tythings, wapentakes, laths, or other subdivisions, by whatever names or titles they are called or distinguished, are not generally to be approved of. However necessary the knowledge of these may be with respect to the internal police of the kingdom in a civil sense, as being anciently established, they are seldom of importance sufficient, when considered in relation to the geography of modern times, to become the subjects of general study. The maps of kingdoms may be dissected into their several counties or provinces, and those of the different quarters of the world into their several kingdoms; in other cases, the student may use this method or not, as he thinks best, as I do not presume either to recommend or condemn it.

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plicated and extensive map, in this dissected state, and give to each city, town, or village, its proper place and situation in the general description.

LESSON V.

A few things remain to be remarked of the maps of counties and small districts, which may not be wholly unworthy our attention. The several subdivisions into which these limited and confined maps are separated should be particularly noted, and the various names and characteristics by which they are respectively distinguished carefully observed. I have before hinted, that their extent and situation should also be remarked, and the places most worthy of regard in the several districts fixed on the memory. But this particular information should not be considered as absolutely necessary in all cases; for general purposes, a general acquaintance will commonly suffice; and it is only in order to a perfect acquaintance with every thing relating to them, and where the most circumstantial knowledge of the geography of any particular county is advisable, that this method is necessary to be recommended.

Another thing remarkable in a good map of a county, is an accurate representation of mountains, forests, parks, chases, and other noted places it includes. From hence, and by an accurate attention to the number, size, and course of the rivers it contains, a general idea may be formed of the face of a county. To this knowledge should be added a due attention to some comprehensive description of such county, the careful perusal of which, and a regular application to the map of such county respectively, will enable any person of tolerable capacity to join in almost any conversation relating to the general state of such county. What would render these particular objects the more striking, is to distinguish each of them by some slight colour peculiar to itself, and characteristic of its nature, if necessary; but this is too frequently neglected in the best maps, and such as are sold in the shops as coloured. Hence it would be advisable for persons of ingenuity

to buy their maps plain, and to colour them according to the directions which will be hereafter given; the singular advantage of which improvement must be obvious, especially if done as already intimated.

In these we may observe, that a due attention to particular cities and towns, or other places of note or eminence, may be included. To distinguish these by some characteristic colour, must be highly proper and advisable; but this matter is very seldom attended to. They strike the eye at the first glance, and the beauty of maps, as well as their utility, is greatly improved by a proper attention to such minutiae.

LESSON VI.

Having sufficiently discussed the nature of maps on a smaller scale, we may naturally proceed to such as are larger and more comprehensive. What has been said of the different counties or divisions in the same state or kingdom, will equally apply to such as include several states or kingdoms. By attending to the situation and extent of each, the capital or principal cities of the several kingdoms or states, with their direction to, and distance from each other, every part of the knowledge requisite to a general acquaintance with them may be readily obtained. And as the latitude and longitude are always expressed in the margin of such larger maps, the observations already made will be also essentially serviceable in this stage of our enquiries.

One thing more must be observed of such large maps as include several provinces or kingdoms, which is sometimes also to be seen in smaller maps. The several lakes and seas, gulphs, and other remarkable appearances, whether wholly inland, and in the interior parts of a country, or adjoining to the sea, should be carefully noted, and the particular provinces or states in which such appearances are found, should be attentively considered. Thus, by a due observation of the several circumstances found in maps, and a careful attention to such remarks as have here been laid down, it is scarce possible for any person of common ingenuity

or

or application to mistake in any thing relating to the knowledge of the true nature of maps.

By such an orderly and regular progression from country to country, and from kingdom to kingdom, it cannot be doubted that the result of our labour and enquiry must be such, as amply to reward our trouble and attention to matters of such great importance to science. And in this manner it will not be difficult to understand the maps of the four general quarters of the world, Europe, Asia, Africa, and America. These being properly and carefully attended to, we may proceed to a knowledge of maps of the world, as commonly delineated on two hemispheres, or apparent circles, (already alluded to in Lesson II.) though in reality they are intended to represent two semi-globes. Thus the situation of each of these general quarters appears at once to the eye; and the comparative extent and size of them, with respect to each other, becomes plain and obvious. These will greatly expedite the knowledge of Geography as a science, to which I should now proceed; but because this is so largely treated in Mr. Fenning's *Use of the Globes*, and in the last edition of his *Young Man's Book of Knowledge*, just printed, as well as in the Rev. Mr. Turner's *New and Easy Introduction to Universal Geography*, I shall proceed to treat, in the next place, of Navigation.

Of NAVIGATION.

IT is unnecessary, and indeed impracticable, within our narrow limits, to give a history of Navigation, or the degrees of perfection it arrived to in different ages from its first rude state. As it is known to consist in the art or management of conducting a ship from one port to another, we shall consider it as depending on Geometry and Trigonometry, and but briefly touch upon some useful matters relating to it.

The nature of a compass being so well known, it is scarce requisite to give an explanation. Great care
E e 2 however

however should be observed in the choice of them, as they are very often injudiciously made by pretenders to the art; or negligently put together for the sake of cheapness, or perhaps of greater profit to the retailer. But surely no sensible person would grudge a small additional expence, who considers that a ship and her cargo, with the lives of the commander and crew, depend upon this instrument. It is needless to give the figure of it, as half an hour's sight of one is much preferable to the largest description for the information of the young student; especially as it is described in the Young Man's Book of Knowledge, which our proposed brevity obliges us frequently to refer to.

The tendency of the magnet, which is a rich iron ore, to point northwards and southwards when it is suspended, so as to play freely, has occasioned the application of this metal to the compass for the purposes of navigation. But this tendency, through continued observation, has been found to vary. About 200 years ago it formed an angle, with the true north line, of more than 11 degrees to the east; but this was gradually decreased to nothing in somewhat less than 80 years, and is now, after 130 years more, about 16 degrees to the westward, and some say more. From hence it has been conjectured, (how truly time must determine) that this variation is almost equally progressive towards the west; but whether it is confined to certain limits, from whence it will hereafter return towards the north, or whether it will continue its westerly progression, is more curious than useful, since almost any common seaman knows the method of finding the variation at any time when the sun can be seen at his rising or setting.

But the magnets commonly used for the seamen's compass are of steel, to which the magnetic virtue is artificially communicated. Those which are straight and square at the ends are best, where they can be procured, as much less liable to error than the common pointed ones; and if our narrow limits would permit, the method of making and applying them to use might be shewn. At present, we must content ourselves

ourselves with these short remarks, and proceed to some other observations necessary to be known.

It has been observed, under our Geographical lessons, that the miles contained in a degree of longitude are variable, and diminish gradually in number as the distance from the equator or the increase in latitude. The young student is desired to remember this, and from hence to infer the utility of such notes as will be annexed to the examples hereafter given. We shall here present him with a table of geographical miles contained in a degree of longitude on each parallel or degree of latitude, which, though commonly given under geography, may be applied to the purposes of Navigation with great advantage, and has been purposely corrected for this work.

E c 3

A TABLE

A TABLE, shewing the Number of Miles and hundredth Parts of a Mile contained in a Degree of Longitude on each Parallel of Latitude from the Equator to the Pole.

Deg. of Lat.	Miles.	Parts.	Deg. of Lat.	Miles.	Parts.	Deg. of Lat.	Miles.	Parts.
1	59	99	31	51	47	61	29	08
2	59	96	32	50	93	62	28	15
3	59	91	33	50	37	63	27	22
4	59	85	34	49	79	64	26	28
5	59	77	35	49	20	65	25	33
6	59	67	36	48	59	66	24	38
7	59	56	37	47	96	67	23	42
8	59	43	38	47	32	68	22	45
9	59	28	39	46	67	69	21	48
10	59	11	40	46	00	70	20	50
11	58	92	41	45	32	71	19	52
12	58	71	42	44	62	72	18	53
13	58	49	43	43	91	73	17	54
14	58	25	44	43	19	74	16	54
15	57	99	45	42	45	75	15	54
16	57	71	46	41	70	76	14	54
17	57	41	47	40	94	77	13	53
18	57	09	48	40	17	78	12	52
19	56	75	49	39	39	79	11	50
20	56	40	50	38	60	80	10	48
21	56	03	51	37	80	81	9	45
22	55	65	52	36	98	82	8	42
23	55	25	53	36	75	83	7	38
24	54	83	54	35	31	84	6	34
25	54	40	55	34	45	85	5	29
26	53	95	56	33	58	86	4	24
27	53	49	57	32	70	87	3	18
28	53	01	58	31	81	88	2	12
29	52	51	59	30	91	89	1	06
30	52	00	60	30	00	90	0	00

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As the three principal branches of Navigation, Plain Sailing, Mercator's Sailing, and Circular Sailing, are treated of and explained in the Book of Knowledge, I shall briefly state the method of Middle Latitude Sailing, in a way not generally noticed, for which the preceding table has been given.

Of Sailing by Middle Latitude.

By Middle Latitude Sailing we understand the degree, &c. of latitude exactly in the middle between the latitude sailed from and the place the ship is now in. The use to be made of this is, to find out the difference of longitude by the departure, which, though not strictly true, because the miles contained in a degree of longitude on the different parallels do not diminish equally, is generally near enough for practice.

PROBLEM I. If a ship sails towards the south-west, upon a course which makes an angle with the meridian of 30 degrees, to the distance of 100 miles, what is her difference of latitude and longitude, and what latitude is she now in, supposing her to set out from 45 deg. 30 min.

1. For the difference of latitude, say, as radius or the S. of 90 deg. is to the distance sailed, 100 miles, so is the C. S. of the angle of the course, 30 deg. to the difference of latitude.

2. Then for the difference of longitude, say first for the departure, as radius is to the distance sailed, so is the S. of the angle of the course to the departure.

3. Take half the difference of latitude, and subtract it from the latitude given by the question, and it will leave the middle latitude. Find by the above table how many miles are contained in a degree of longitude for that parallel of latitude, by which divide the departure, and the quotient will give the degrees, &c. of longitude, to be added or subtracted as occasion requires.

Note 1. By the above proportions, the difference of latitude will be 86.60, or 86 min. 36 sec. and consequently

quently the latitude the ship is now in must be 44 deg. and above 3 min. the departure is 50, and the miles contained in a degree on the parallel of 44 deg. 47 min. or the middle latitude are 42.59, and the difference of longitude will therefore be 70.4. If then the longitude from London before was 5 deg. 25 min. west, the difference of longitude added, as the ship sailed towards the west, will make the longitude the ship is now in to be 6 deg. 35 min.; but if the ship had been in east longitude, the difference of longitude must have been subtracted.

Note 2. The number of miles contained in a degree on any parallel of middle latitude is found by this proportion, as radius or the S. of 90 deg. is to the C. S. of middle latitude, so is the S. of half a deg. or 30 min. to the number of miles contained in half a degree of longitude on that parallel, which double for the miles in a degree; then for the whole difference of longitude, whether greater or less than a degree, say, by the Rule of Three, as the last found number is to 60, so is the departure to the whole difference of longitude.

PROBLEM II. If the same ship, when in latitude 44 deg. 3 min. north, and 6 deg. 35 min. west longitude, sails 100 miles more on a course betwixt the south and east, which makes an angle with the meridian of 15 degrees, what latitude and longitude will she then be in?

For the Difference of Latitude.

As radius is to the distance sailed, so is the C. S. of the angle of the course to the difference of latitude, which in this case is 96.59, or 97 minutes nearly, which subtracted from 44 deg. 3 min. will leave 42 deg. 26 min. for the latitude the ship is now in.

For the Departure and Difference of Longitude.

As radius is to the distance, so is the S. of the angle of the course to the departure, 25.87 miles. Then having found the middle latitude, as directed under the last Problem, and the miles contained in a degree of longitude on that parallel, find the whole difference of longitude, as before, which will be 35.5 min.; and as the

the ship sailed towards the east, subtract it from 6 deg. 35 min. and the remainder 6 deg. will give the longitude of the ship.

Note, If the ship had been in east longitude, the difference of longitude must have been added. It is an infallible rule to add east to east and west to west, but to subtract east from west and west from east.

These two examples are sufficient to shew the nature of Navigation. Before a person is qualified to make an observation, and thereby to correct his latitude and longitude by calculation from the log, which is often necessary on account of currents, the ship's lee way, and other causes known to seamen, which make such calculations vary from truth, it will be necessary to be more fully acquainted with these matters by regular instruction or study than our narrow limits will permit. The Editor is preparing for the press a small work of this nature, which will comprehend in a very small compass all the knowledge generally necessary and useful for the practical navigator. It is necessary now to proceed to Astronomy.

OF ASTRONOMY.

LEAVING the confined track pursued by the writers of former Companions, I shall neither limit my observations on this sublime science to a few calculations only of some useful matters, or merely to give a theory of the planetary system. I propose, in a short method, to treat of both, as equally necessary to direct our student into the knowledge of creation's wonders; to startle and amaze him, but not to leave him in Egyptian darkness; to lead him by the hand to the contemplation of the starry heavens, and to expand and enlarge the faculties of his mind to perceive the beauty and harmony of the Almighty's stupendous works.

The Solar System, or that which regards the Sun as its center, consists of seven planets, each receiving their

their light and heat from the Sun; some of these being attended by one or more moons, which regard their respective planet as a center, and revolve round the Sun also with it. Each of these shall be considered briefly in their order, first premising a few words respecting the Sun, and proceeding from the planet nearest to him to that which is most remote; and observing that every planet moves in an orbit round the Sun nearly, though not exactly, circular, subject to this invariable law, that the mean distance is in proportion as the cube of such distance to the square of its time in revolving round the Sun.

The SUN is now almost universally considered as a very large body of fire, which gives light and heat to all the planets, with their satellites, in the solar system; and for this reason it is placed in the center, having no other motion than a periodical one round its own axis in about 25 days and a quarter. Its diameter by calculation* is 970967 miles, its circumference 3050390 miles, its superficies 2961828027130 square miles, and its magnitude or bulk will be above 479306212336 millions, or more than 479306 millions of millions of solid miles, a number almost surpassing belief, did not the laws and proportions of distant bodies confirm it. It needs only to be remarked farther, that Mercury is the planet nearest the Sun, then Venus, after that the Earth with the Moon, after that Mars, then Jupiter, then Saturn, and last of all, for the honour of the present age and the present reigning prince in this kingdom, the Georgium Sidus has been discovered, at a

* As this calculation may be considered by some as too great, a method is obvious for correcting it. Having nicely measured the Sun's apparent diameter in minutes, &c. of a degree, by a good micrometer (an instrument peculiarly calculated for taking the diameters of stars or planets) the diameter in miles is easily found by this proportion; as the horizontal parallax of the star or planet, in its lowest denomination, is to the Earth's diameter in miles, so is the apparent semi-diameter of such star or planet, to its diameter in miles. This proportion, when the Sun's parallax is taken at 8" 39", and his semi-diameter at 16' 13", will make the Sun's diameter to be 896509 miles; and this is much more than has been generally supposed.

distance

distance very remote, of which more will be said presently. I shall begin with those nearest to the Sun, as proposed.

At the distance of 37 millions of miles nearly from the Sun we find the orbit of MERCURY. He moves round the Sun in the space of 87 days 23 hours and 16 minutes, his diameter being about 3000 miles, his circumference 9425, and his magnitude more than 14137 millions of miles. His greatest elongation from the Sun never appears to us to be much more than 27° ; hence he is seldom seen by the naked eye, but whenever he is visible, appears of a very bright red colour. His light from the Sun is above six times stronger than ours at the Earth, and consequently the heat proportionably intense.

VENUS is situate at a distance from the Sun, though not so near as Mercury, yet nearer than the Earth; and the light and heat she receives from him are nearly double to that received upon our Earth. She appears of a yellowish white, and moves round the Sun in her orbit in 224 days 16 hours 49 minutes, at a mean distance of nearly 69 millions of miles. Her diameter is 9330 miles, her circumference 29311 miles, and her magnitude in solid miles about 425250 millions of miles. Some astronomers have supposed her to have a satellite, or attendant moon moving round her, at the distance of three-fifths of her diameter; but its form being irregular, and diameter not one-fourth of that of its primary, and but ill defined, made further notice of it unnecessary. The greatest elongation of Venus from the Sun, as she appears from the Earth, is about 48 degrees.

The EARTH, being the planet which we inhabit, comes next in our way, at the distance of 95 millions 173 thousand miles from the Sun. Its diameter is 7970 miles, its circumference 25038, its superficies in square miles is above 199 millions and a half, and its magnitude or bulk in cubic miles somewhat more than 265 thousand and 78 millions. Its periodical time is 365 days

days 5 hours 48 minutes and 55 seconds, being the true solar year, or the time in which it moves round the Sun in its orbit. Besides this annual and progressive motion, its daily rotation upon its axis from west to east in 23 hours and about 56 minutes occasions the returns of day and night every 24 hours*; which 24 hours is compounded of the time of the rotation just mentioned, and of the daily addition of nearly 4 minutes, being the daily progression of the Earth in her orbit.

The Moon, which is the Earth's satellite or attendant, and accompanies it in its progress round the Sun, is distant from the Earth about 240000 miles. Her diameter is computed to be about 2175 miles, her circumference 6833, and her magnitude or bulk 5,387,393,437 solid miles. She moves round her axis in 27 days 7 hours 43 minutes, and in the same time round the Earth; but because the Earth has gradually advanced about 59' 8" in a day during this period, it will take up 29 days 12 hours 44 minutes and about 3 seconds, before she comes into the same situation with respect both to the Earth and Sun, for so much is the mean time betwixt one new Moon and another. The Moon at different times during this revolution appears differently shaped, being sometimes gibbous or horned, and gradually increasing from her change to her full, when she appears to have a large broad face, being then opposite to the Sun, and the Earth at that time being betwixt her and the Sun; from thence

* The Earth's motion in her orbit not being the same with that of her rotation upon her axis, but inclined at an angle of 23° and about 28', sometimes from it and sometimes towards it (a change which is the necessary consequence of its globular form, and not from any real change in its motion), the variation in the duration of days and nights is from hence obvious, and their difference in the several parts of our globe naturally accounted for. By this motion, the Earth from Midsummer to Christmas, or from the summer to the winter solstice, as they are called, will seem gradually to shun the Sun, whence it will as gradually return, and from Christmas to Midsummer seem to approach it. For although the day and night, taken together, are always equal to 24 hours, no two days together are exactly of the same length.

the

she gradually declines as she moves more to the eastward, till she comes betwixt the Earth and the Sun, when she does not appear at all. If the Moon moved in the same direction with the Earth, the Sun would be eclipsed by her every new Moon, and the inhabitants of our Earth would be deprived of his light; and the Moon in like manner would be eclipsed by the Earth at every full Moon, as then being betwixt the Sun and her; but these appearances or phenomena, as they are called, are not so frequent, because the Moon's orbit makes an angle of about 5° with the Earth's orbit, and no eclipse can happen but when she is so near the intersection or crossing those orbits, that the two semi-diameters are less than the distance of the orbits. But I must refer the reader to Mr. Turner's *View of the Heavens* for a further account, and to the *Heavens surveyed*, by the same author; in which latter work, a very ingenious method of calculating the planets places, and other useful knowledge, may be found, of great importance to the young student.

The planet MARS, at the distance of more than 145 millions of miles, revolves round the Sun in 686 days 23 hours 27 minutes. His diameter is 5400 miles, circumference near 17 thousand, his superficies somewhat more than 91 millions and a half, and his magnitude in solid miles nearly 82448 millions. He always appears of a ruddy colour, somewhat muddy and troubled, being encompassed with a very cloudy atmosphere.

The planet JUPITER is the next in our way. His diameter is 94000 English miles, circumference 295310, superficies in square miles nearly 27760 millions, and his bulk or magnitude in cubic or solid miles almost 435 millions of millions of miles. His orbit is nearly 495 millions distant from the Sun, and he performs his revolution in 4332 days 12 hours 20 minutes, or almost 12 years. He appears of a splendid and beautiful white colour. Jupiter is constantly attended by four satellites or moons, which regard him as a center, and move round the Sun with him. That nearest

F f

his

his body moves round its orbit in 1 day 18 hours 28 minutes and 36 seconds, at the distance of about 5.6 semi-diameters of that planet's body, or 263200 miles from the center, and is second in magnitude of those four. The next revolves in 3 days 13 hours 17 minutes and 54 seconds, at the distance of 9 semi-diameters of Jupiter's body, or 423000 miles, and is third in magnitude. The third revolves in 7 days 3 hours 59 minutes and 36 seconds, and is the largest of the four; its distance is 14.5 semi-diameters, or 681500 miles. The fourth at the distance of 25.25 semi-diameters, or 1186750 miles, performs its revolution in 16 days 18 hours 5 minutes and 12 seconds, and is least of all the satellites. But these moons do not always appear according to their distance; for the remotest will often seem to be the nearest to a spectator on the Earth, and that which is really the nearest to be farthest remote. They sometimes appear by a good telescope to pass over the face of Jupiter, when they pass between the Earth and the planet, and at other times are eclipsed by him when they pass behind him. But of these enough has been said for the information of the young student in Astronomy, and more may be found in the works already referred to under the Moon.

SATURN has, till lately, been considered as the highest planet, at the distance of 908 millions of miles nearly from the center of the system. His diameter is 78000 miles, circumference 245045, superficies in square miles nearly amounts to 19113 millions and a half, and its magnitude in cubical miles somewhat more than 248 millions of millions and 475427 millions of miles. The time of his revolution round the Sun is 10759 days 6 hours 36 minutes, being almost 29 years and a half. His colour is that of a dim lead, and is easily known, his face being always round and full. Saturn is attended by five satellites or moons, which regard him as a center, and move round the Sun with him. That which is nearest his body moves round him in 1 day 21 hours 18 minutes and 26 seconds, at the distance of $4\frac{1}{3}$ semi-diameters from his center, or 165750 miles. The next revolves in 2 days 17 hours

41 minutes and 10 seconds, at the distance of $5\frac{3}{4}$ semi-diameters from his center, or 224250 miles. The third moves round the body of Saturn at the distance of 8 semi-diameters, or 312000 miles, in 4 days 12 hours 25 minutes and 10 seconds. The fourth at the distance of 20 semi-diameters, or 780000 miles, revolves about him in the space of 15 days 22 hours 41 minutes and 28 seconds. The fifth and farthest distant is computed to be 59 semidiameters, or 2301000 miles, and performs its revolution round him in 79 days 7 hours and 46 minutes. Saturn will frequently eclipse these moons, and be eclipsed by them; or they will appear as spots on his face when they pass betwixt us and the planet, and be obscured by the planet when they pass beyond him. As these only are discernible by a telescope, no more need be said of them in this place.

We now come to the GEORGIUM SIDUS, or New Planet, which was discovered by Mr. Herichel, the Astronomer Royal at Windsor, in 1781. The substance of that discovery was communicated to the public nearly in the following words: "On the 13th of March 1781, between the hours of ten and twelve at night, as Mr. Herichel, the Astronomer Royal at Windsor, was attempting to discover the parallax of the stars, by means of double, triple, and quadruple fixed stars, he discovered a *new planet*, belonging to our system, as he was examining the small stars near the feet of Gemini, which he named GEORGIUM SIDUS, in honour of our present sovereign. It is seldom to be seen very plainly by the naked eye. It is nearly the colour of Jupiter, or somewhat paler and more faint, and its apparent diameter about 4 seconds. By the calculation of M. de la Lande we are told, that his distance from the Sun is 19 times farther than the Earth is, and its diameter $4\frac{1}{2}$ that of the Earth." I shall shew the method of deducing from these data as many of its properties as possible.

Note, That in order to distinguish the several parts of the heavens from each other, and consequently to

know the places of the planets and fixed stars, the ancient astronomers divided the whole into 12 signs, each of 30° , and by the different positions of the stars in and near the ecliptic, devised those imaginary figures, which have been since retained, the better to discover their situation. The first was called *Aries*, or the *Ram*; next *Taurus*, or the *Bull*; then *Gemini*, or the *Twins*; *Cancer*, or the *Crab*; *Leo*, or the *Lion*; *Virgo*, or the *Virgin*; and when the Sun seems to be in any of these signs, it is summer in our northern latitudes: the other six are *Libra*, or the *Balance*; *Scorpio*, or the *Scorpion*; *Sagittary*, or the *Archer*; *Capricorn*, or the *horned Goat*; *Aquarius*, or the *Water-bearer*; *Pisces*, or the *Fishes*; and when the Sun appears to be in any of them, we have winter.

Example. The apparent diameter of a planet being given, with its distance from the Sun in diameters or distances of any other known planet, and the diameter of such planet also given in diameters or other properties of the known planet, to find the diameter, circumference, superficies, and magnitude of such planet, with its distance from the Sun, the time of its revolution, and daily mean motion in the ecliptic, and also its parallax, with the other requisites; as, for instance, in those given above for the Georgium Sidus.

First, Multiply the Earth's diameter by 4.5, for the diameter of the planet, which is 35865 miles, whence its circumference is 112673, its superficies in square miles 4041034504, and its magnitude in solid miles 24155283745628. Then for the distance, multiply the Earth's distance from the Sun by 19, and the product will be 1808 millions 287 thousand miles for the distance of the planet, which doubled gives the diameter of its orbit, and the circumference accordingly becomes 11361 millions 828878 miles.

Secondly, For the time of its revolution in its orbit round the Sun, say, by the Rule of Three, as the cube of the Earth's distance from the Sun, is to the square of the time in seconds of its revolution, so is the cube of the planet's distance from the Sun, to the square
of

of the time in seconds of its revolution; the square root of which being extracted, gives 2613 million 556540 seconds; reduce this into days, and the time will be 30249 days 11 hours 55 minutes and 40 seconds, equal to * 82 years 298 days 23 hours 55 minutes and 40 seconds, allowing 12 hours for the two odd years from leap-year. Its daily mean motion in the ecliptic will consequently be $42'' 50'''$ and $37'''$, and its mean annual motion $4^{\circ} 20' 48'' 39''' 24'''$.

Note, That this use of the Square and Cube Roots jointly was referred to at the end of the uses of the Cube-Root, in p. 247.

Lastly, For its parallactic angle, or the angle of its horizontal or greatest parallax, say, by the Rule of Three Inverse, as the Earth's semi-diameter is to the planet's apparent diameter at the Earth, so is the planet's semidiameter to the parallactic angle, equal in this case to $\frac{8}{9}$ of a second.

Note, These several dimensions are deduced, on a supposition that the planet, at the time of observation, was at its mean distance from the Earth. If it was betwixt the mean distance and perihelion distance, all its dimensions, except the parallax, will be larger; if it was any where betwixt the mean and aphelion distance, its properties will be smaller, except the parallax, which in this case will be larger. Whether it revolves upon its axis as the other planets, however probable, is not certain, and consequently the length of their day must remain unknown. The present received situation of this planet nearly agrees with this idea; its mean motion since its discovery being about 22° , and the small stars near the feet of Gemini being

* A modern author, whose employment places him in a situation the most likely to know the result of modern observations, gives the revolution at 83 years and 130 days, which is about half a year more than the other; but he gives no method of discovering, by means of proper data, how to find the period of such revolution, only placing it in a table of the affections of the several planets as a matter to be taken for granted. When this calculation was made, the author had not seen the work alluded to.

in about 2° of Cancer, the true place at the beginning of this year (1787) being 24° of Cancer, shews the conformity of this supposition with truth, and consequently proves that the planet was then at or near its mean distance from the Sun.

Of the fixed Stars.

HAVING said as much as is necessary upon the Planetary System, I shall pass by those occasional phenomena called Comets, and proceed to the fixed Stars, so called, because they appear at the same distances from each other, and have an uniform progression in the ecliptic of about $50''$. Their number has, by different astronomers, been differently represented, according to the goodness of the instruments with which they have been examined. Our limits will not allow us to be particular upon them; suffice it to say, that such is the vast distance of these stars, that the nearest of them, called *Sirius*, or the Great Dog Star, is supposed to be at least two millions of millions of miles distant, and others vastly more; and it is probable that each of these may be a sun to other planetary systems. Instead of enlarging, the student must be referred to Mr. Turner's *View of the Heavens*, or *short System of modern Astronomy*, already mentioned. I had intended to annex two tables of the fixed stars; first, of those which have very high north latitude, and are attendants, as it were, upon the north pole, never setting in our hemisphere; and, secondly, of those which do not much exceed 5° of latitude, either north or south, and so fall within the compass of the Moon's visible way; but as their uses will best appear in Navigation, it may not improperly be dispensed with in this place. Supposing the student to be in possession of tables of logarithms, with the logarithm sines, tangents, and secants, one or two useful problems may be added before we proceed.

It has been observed, in speaking of the Earth's affections and properties, that her motion in her orbit is inclined

inclined from the ecliptic in an angle of $23^{\circ} 28'$, which is called her declination; but since this declination continually varies, as the Sun appears to recede from it, more or less, being greatest at Midsummer and Christmas, the one in north and the other in south declination, and nothing at all in the Spring and Autumn, I shall first shew the method of finding this.

1. Suppose the Sun to be 30 degrees distant from the first point of Aries, or in 0 degrees of Taurus, and the greatest declination to be $23^{\circ} 28'$, say, as radius, or the sine of 90° , is to the S. of 30° , the distance from Aries, so is the S. of the greatest declination, $23^{\circ} 28'$, to the S. of present declination, or $11^{\circ} 29' 6''$.

Note, That the distance must always be taken from Aries or Libra, because in those two points the declination is nothing, and must never be more than 90° .

2. If the Sun's present declination be known, and the latitude of the place, the time of the Sun's rising and setting may be also known, and consequently the ascensional difference, or degree of time that the Sun rises or sets before or after six o'clock. Say, as radius, or S. of 90° , is to the T. of the Sun's declination, (suppose as already found) $11^{\circ} 29' 6''$, so is the T. of the latitude, or the elevation of the pole $51^{\circ} 32'$ (at London), to the S. C. of an arch; if the declination was north, it is semi-nocturnal, but if south, semi-diurnal; or the last number is the S. of the ascensional difference, which, converted into time, (allowing 15° for every hour, $15'$ for every minute, &c.) is to be subtracted from 6 for the time of the Sun's rising when the declination is north, but added when it is south. In either case, the time of the Sun's rising is 59 min. 16 sec. before six, and its complement to 12 is the time of setting, which doubled gives the length of the day.

Note, As most of the common problems may be resolved at sight, by the help of my improved Card Dial hereafter given, and proportions for the rest being given

given in Mr. Fenning's *Book of Knowledge*, to which the student must be referred; I would wish to lead him in the next place to an acquaintance with Dialling, to which I hope he will be glad to accompany me.

Of D I A L L I N G.

THE use of Dials is so well known, that every one must wish to know the method of making them; and this is the more advisable and necessary, because very few are qualified for it, even of those who attempt it. Hence it is observable, that most dials are more or less erroneous as the time is distant from 12 o'clock, when alone, supposing them to be truly placed, they point out the true time. But there is too much reason to suppose, that the mechanic in erecting them may be as ignorant as the delineator; from whence the errors may be almost incredible, though the expence probably is as great, or greater, than would have procured a good dial, drawn correctly and judiciously, and erected according to rules of art.

A polar dial is what we have no occasion for. An equinoctial dial in like manner can only be useful to those who live on the equator, or very near it, and therefore it is unnecessary to those for whose advantage this work is intended. An horizontal dial is most common, and generally most useful, which I shall here present, with the method of making it in any latitude.

Of an Horizontal Dial.

Where this dial can be so placed as to receive the Sun's direct rays, from his rising to his setting, there will be no need to use any other. This is to be placed flat or horizontal (whence its name) on an upright strong post or pillar of wood or stone, as every one knows. The proportion for finding the arches or distance

distance from the XII o'clock line of the hours, half hours, and quarters, is as follows, accounting 15° to every hour, $7^{\circ} 30'$ to half an hour, and $3^{\circ} 45'$ to every quarter; as radius or S. of 90° , is to the S. of the latitude of the place, so is the T. of the $\angle$ of the time from noon, to the T. of an arch, the chord of which being applied to the outer circle from XII, shews the point through which from the center to draw the hour line, half hour, or quarter respectively.

As our limits will not allow us to insert a table of logarithms, with the logarithm fines and tangents, for the use of those who may not have them, the following table, corrected from the errors of other authors by calculation, is inserted, one or other of which latitudes will pretty well serve for all places in England, Scotland, or Ireland.

A TABLE

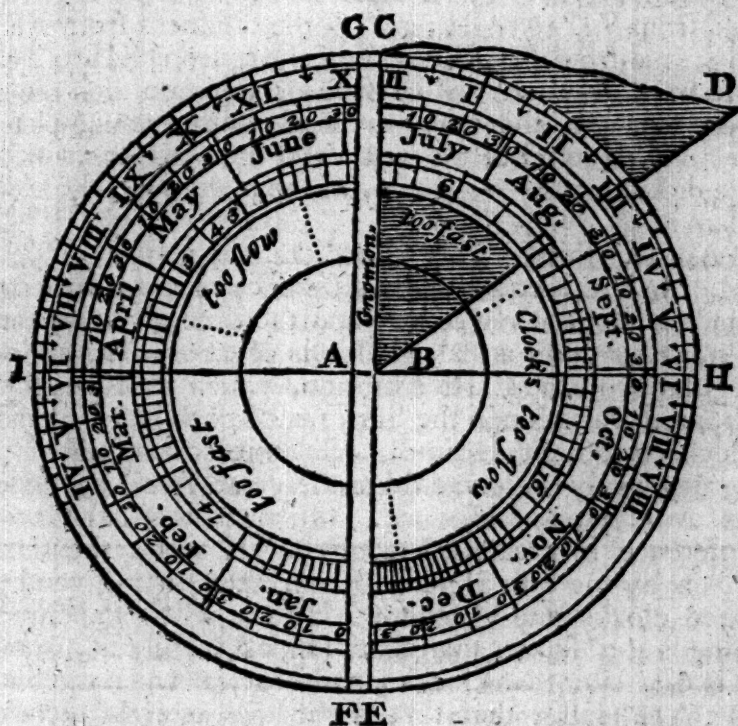
A TABLE of DISTANCES to be taken
from the Chords, for all the Hours, Half Hours, and
Quarters, in Horizontal Dials, from Lat. 50° to
Lat 57° inclusive.

Hours and their Parts.		Lat. 50.	Lat. 51.	Lat. 52.	Lat. 53.	Lat. 54.	Lat. 55.	Lat. 56.	Lat. 57.
		D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.
XII		0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
1	3	2 52	2 55	2 57	3 0	3 2	3 4	3 7	3 9
2	2	5 45	5 50	5 55	6 0	6 5	6 9	6 14	6 18
3	1	8 40	8 47	8 55	9 2	9 8	9 15	9 22	9 28
I XI		11 36	11 46	11 55	12 5	12 14	12 23	12 31	12 40
1	3	14 35	14 47	14 59	15 10	15 21	15 32	15 43	15 53
2	2	17 36	17 51	18 5	18 18	18 32	18 45	18 57	19 10
3	1	20 42	20 58	21 14	21 30	21 45	22 0	22 14	22 28
II X		23 51	24 10	24 28	24 45	25 2	25 19	25 35	25 50
1	3	27 6	27 26	27 46	28 5	28 24	28 42	28 59	29 16
2	2	30 27	30 48	31 10	31 30	31 50	32 9	32 28	32 46
3	1	33 54	34 17	34 39	35 0	35 21	35 42	36 1	36 20
III IX		37 27	37 51	38 14	38 37	38 58	39 19	39 40	39 59
1	3	41 8	41 33	41 56	42 19	42 42	43 3	43 23	43 47
2	2	44 57	45 22	45 46	46 9	46 31	46 52	47 13	47 33
3	1	48 54	49 19	49 42	50 5	50 27	50 48	51 8	51 27
IV VIII		53 0	53 23	53 46	54 8	54 29	54 49	55 9	55 27
1	3	57 14	57 36	57 58	58 18	58 38	58 57	59 15	59 33
2	2	61 36	61 57	62 16	62 35	62 53	63 11	63 27	63 43
3	1	66 6	66 24	66 42	66 58	67 14	67 29	67 44	67 58
V VII		70 43	70 59	71 13	71 27	71 41	71 53	72 5	72 17
1	3	75 27	75 39	75 50	76 1	76 11	76 21	76 31	76 39
2	2	80 15	80 23	80 31	80 38	80 45	80 52	80 59	81 5
3	1	85 7	85 11	85 15	85 19	85 22	85 25	85 29	85 32
VI		90 0	90 0	90 0	90 0	90 0	90 0	90 0	90 0

This Table is very easy; for having drawn the two
meridian lines of your dial, and upon the several centers
(as will be shewn presently) described semicircles, if
you

you wish to take off, for example, the chord of IX o'clock in lat. 51° , the table will shew you that it is $37^{\circ} 51'$ to be taken from a line of chords made from the same radius.

If you wish to be more exact in intermediate latitudes, suppose for London, which is $51^{\circ} 32'$ north latitude, use this proportion; as the difference of the two nearest latitudes, $60'$, is to the whole difference of their chords, in this case $24'$, so is $32'$, to $13'$ nearly. If this is added to $37^{\circ} 27'$, it will make $37^{\circ} 40'$ for the arch of IX o'clock in the latitude of London.



Having drawn the horizontal line VI VI, cross it at right angles by raising a perpendicular, which shall represent the XII o'clock line; on the middle of which, as a center, draw a semicircle. The thickness of the stile is in the next place to be considered, which must be allowed for in all cases of dialling; and in this case is done by drawing another meridian line parallel to the

the other, and on the center in the VI o'clock line another semicircle, the distance from the former center being exactly equal to the thickness of the stile or gnomon. This should be particularly attended to, though commonly neglected. Then having found the arches of the respective hours, half hours, and quarters, either by the rule or the foregoing table, lay a ruler to the centers respectively on each side, and draw the lines through the circumference of the outermost circle for such hours, half hours, and quarters, as in the figure. It must also be noted, that the distances from VI to V, and from V to IV, are the same as from VI to VII, and from VII to VIII; and so the distances from XII to I, and from I to II, are the same as from XII to XI, and from XI to X. The stile or gnomon then must stand upright, and make an angle with the dial plate or horizon equal to the latitude of the place for which the dial is made.—A view of the plate will fully explain it.

Another thing highly expedient in a good horizontal dial, is the equation or difference of time betwixt the best clocks or watches, and the time given by the Sun's rays upon a dial. This is occasioned by an irregularity in the Earth's motion, which produces this apparent variation in the Sun, whilst good watches and clocks measure true time. Hence it is that they only agree exactly on four days in the year, April 15, June 17, Aug. 31, and Dec. 24. On four other days their difference is greatest, viz. Feb. 11, when the time given by the Sun is 14' 53" later than that given by good clocks and watches; May 15, when the Sun's time is 4' 7" sooner than that of clocks; July 26, when it is 6' 3" later than clocks; and Nov. 2, when the Sun is 16' 12" faster than that of good clocks and watches. Remember then, that as this variation is natural, a good clock or watch should not be altered, if the difference does not exceed that given against the respective days; for no good dial should be without the equation of time in one circle, placed against its respective seasons of the year in another, a matter of much importance in the regulation of a clock or watch.

Perhaps

Perhaps it may be expected that the method of fixing the dial should be shewn, so as to stand exactly north and south at 12 o'clock; for no one has occasion to be told that it should be placed level, on the top of a firm upright post or pillar of wood or stone, or in some similar convenient situation. Fix a board or paper on the top of your post, with 5 or 6 or more circles struck upon one center, at small distances within each other, and draw through the center a line with the fine point of your black-lead pencil, which place as nearly upon a line with the Sun at 12 o'clock as you can guess; a person of common judgment cannot err very much. Then place a pin upright in the center, of sufficient length to shade the circles, and mark the place where the head or top of the pin exactly touches any of the circles; this being done in the morning, observe where the same head touches the same circle in the afternoon, and having found the midway with the compasses, draw a line through it and the center, which shall be the meridian line, on which you must place the meridian lines of your dial.

Note, The Sun's declination continually varying will occasion a small error; but if the observations are made as near 12 o'clock as you can, to have a sensible alteration of altitude, as it never exceeds a minute in an hour, even at the equinoxes (in March and September), and not a second in an hour at the solstices (in June and December), the consequence will be inconsiderable. By attention, therefore, it is obvious that no sensible error can happen, if the experiment is made any time from the 20th of May to the 20th of July, and especially near the longest day; a season certainly the most proper for such a purpose, and the more so, as no error can arise from any variation in the refraction of the Sun's rays at that season, when the declination is as it were stationary for two or three days.

It may be of use to insert in this place a table of the latitude of some of the principal cities and towns in Great-Britain and Ireland, for the use of the young student who would wish to delineate dials for any of those places, or any other place near any of them.

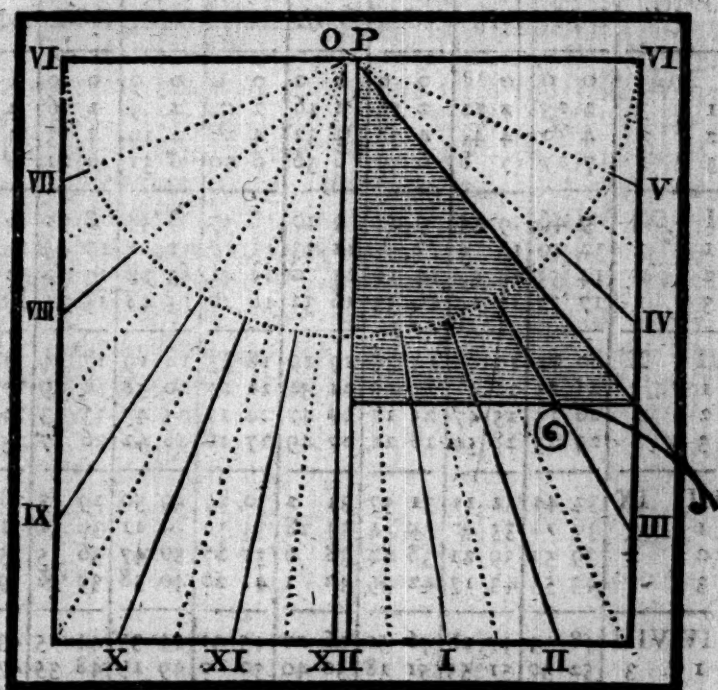
G g

Names

<i>Names of Places.</i>	<i>Latitude.</i>	<i>Names of Places.</i>	<i>Latitude.</i>
ENGLAND.			
St. Alban's	51 45	Stafford	52 50
Bedford	52 10	Truro	50 15
Berwick	55 45	Warwick	52 18
Bristol	51 28	Winchester	51 3
Buckingham	51 58	Worcester	52 14
Cambridge	52 17	York	54 0
Canterbury	51 19		
Carlisle	54 47	WALES.	
Chester	53 10	Cardiff	51 31
Chichester	50 50	Cardigan	52 7
Colchester	52 0	Carmarthen	51 53
Dover	51 7	Carnarvon	53 10
Derby	52 57	Monmouth	51 50
Dorchester	50 41	Montgomery	52 33
Durham	54 55	Pembroke	51 42
Exeter	50 44	Radnor	52 19
Gloucester	51 50		
Guildford	51 12	SCOTLAND.	
Hereford	52 6	Aberdeen	57 6
Hertford	51 42	Dumfries	55 4
Ipswich	52 14	Edinburgh	55 57
London	51 32	Fort William	56 55
Lancaster	54 5	Glasgow	55 52
Leicester	52 40	Inverness	57 33
Lincoln	53 16	St. Andrews	56 18
Newcastle- upon-Tine }	55 3	Wick	58 40
Northampton	52 15		
Norwich	52 45	IRELAND.	
Nottingham	52 45	Armagh	54 30
Oakham	52 37	Athlone	53 20
Oxford	51 45	Carrickfergus	54 45
Plymouth	50 22	Corke	51 54
Portsmouth	50 47	Dublin	53 21
Reading	51 24	Galloway	53 10
Salisbury	51 4	Kilkenny	52 30
Shrewsbury	52 46	Londonderry	55 1
		Waterford	52 7
		Youghal	51 46

Of Vertical Dials.

What is meant simply by a Vertical Dial is one placed against the south side of a church or other building directly facing the south; for if it turns from the south either towards the east or west, it is then called a Declining Vertical Dial, east or west respectively, but either a Direct Vertical Dial, or only a Vertical Dial, when it faces the south. This dial is made in the same manner as a horizontal one; save only that, for



finding the distances of the hour lines, &c. the complement of the latitude must be used. Here follows a table corrected by calculation for several latitudes, one or other of which will pretty well serve for any place in England, Scotland, or Ireland; and to be more exact for parts of a degree of latitude, take the proportions of such parts or minutes as taught for the table on horizontal dials.

G g 2

A TABLE

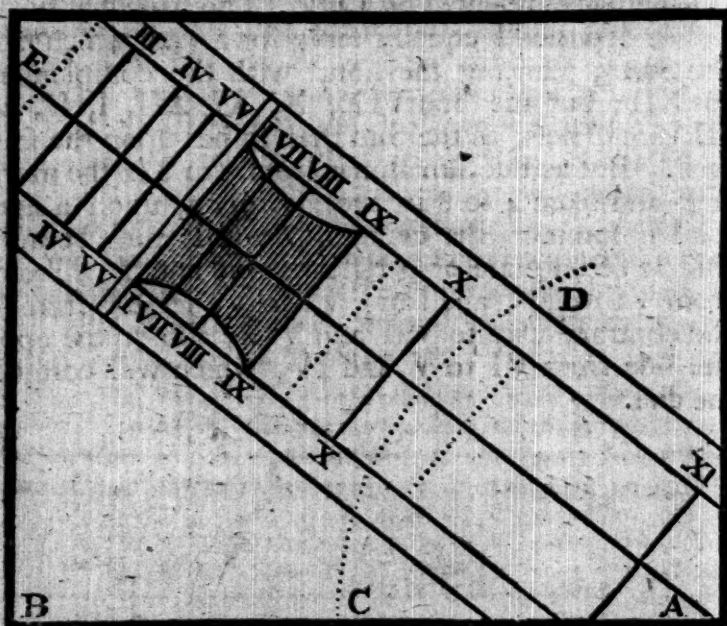
to Lat 57° inclusive.

[illegible]

It is evident from the nature of the figure here given, that each side of the meridian lines O XII and P XII, may be considered as a parallelogram; of which O XII is the longest side, and O VI the shortest, and by making O VI or P VI, which are equal, a radius, sweep the dotted arch, on which set off the respective arches of the several hours, half hours, and quarters, and draw lines through them from O to VI, VII, VIII, and so on to XII, and from P to XII (parallel to O XII), I, II, and so on to VI. The height of the stile must make an $\angle$ at P equal to the complement of the latitude to 90° , the thickness of the stile being represented by O P. The same dial turned upside down will equally serve for a wall which faces the north, marking the hours with the complements to XII; but the hours IX, X, XI, XII, I, II, and III, are useless, as the Sun then shines upon the south wall. But as the Sun shines from 4 to 8 in the morning, and from 4 to 8 in the afternoon, upon a north wall in summer, the centers O and P must be in the middle of a square or parallelogram, and the distances from VI to IV, and from VI to V, set off from VI the contrary way to VII and VIII, also on the opposite side from VI to V and IV, which will complete the dial.

Of an East Dial.

This dial is made for an east wall, and consequently is calculated only for morning hours. The specimen here given shews the nature of it, and it is thus made: Draw the line *AB*, and with any convenient distance, as *AC* for radius, sweep the arch *CD*, and set off the angle of $38^{\circ} 28'$, the complement of the latitude of London from *C*, and draw the line *AE* from the angle



at *A* through this point. Then draw the other lines parallel, as in the figure, at convenient distances, which cross at right angles in *VI VI*; this must be done so far from *E* to allow room for the hours of *V* and *IV*. The hour of *III* is not wanting in our latitude, as the Sun does not rise at London till about 16 minutes before *IV* on the longest day; but in latitude $58^{\circ} 27'$, the Sun on the longest day rises at *III*,
and

and in latitude $61^{\circ} 19'$ at half past II.* They are not therefore introduced as necessary in an east dial at London, or any place having less northern latitude; but are inserted in the plate to shew the nature of introducing them where wanted in higher latitudes. The two parallel lines at VI VI are for the thickness of the stile.

It must not be forgot that the height of the stile is always equal to the radius of a circle, or the tangent of 45° ; thus the tangent of 15° is to be set off each way from the VI o'clock line to V and VII, and that of 30° to IV and VIII. Also the tangent of 45° , which is the height of the stile, will also be the distance from VI to IX, and consequently that distance is always radius; so that the tangent of 60° will extend to X, and that of 75° to XI. The half hours also may be set off, by taking $7^{\circ} 30'$, and the quarters by $3^{\circ} 45'$, to be added respectively to the tangents of the hours; that is, the half hour past IX is set off by the tangent of $52^{\circ} 30'$, and that of half past X by the tangent of $67^{\circ} 30'$, and so respectively for any other.

In like manner a west dial may be made, if the angle of the complement of the latitude is set off as at B in the left hand corner, and all the hour lines drawn that way at right angles to it; the complements of the hours to XII must also be taken, as at equal distances from the meridian or XII. This dial serves for the afternoon, as the east dial does for the morning.

Of the Portable Pocket Dial.

Many other varieties of dials, if our limits permitted, might be introduced; but these are sufficient for most useful purposes. To others, who have no convenience for fixing a dial, or perhaps may be residents of a

* The Sun rises at or before III on the longest day in the most northerly of the western isles of Scotland, the northern counties of that kingdom, and in the Orkneys; at Petersburg a quarter before III, and at half past II at or near Wyburg in the south part of Russian Finland. At Archangel, the Sun rises more than 20 minutes before II in the morning on the longest day.

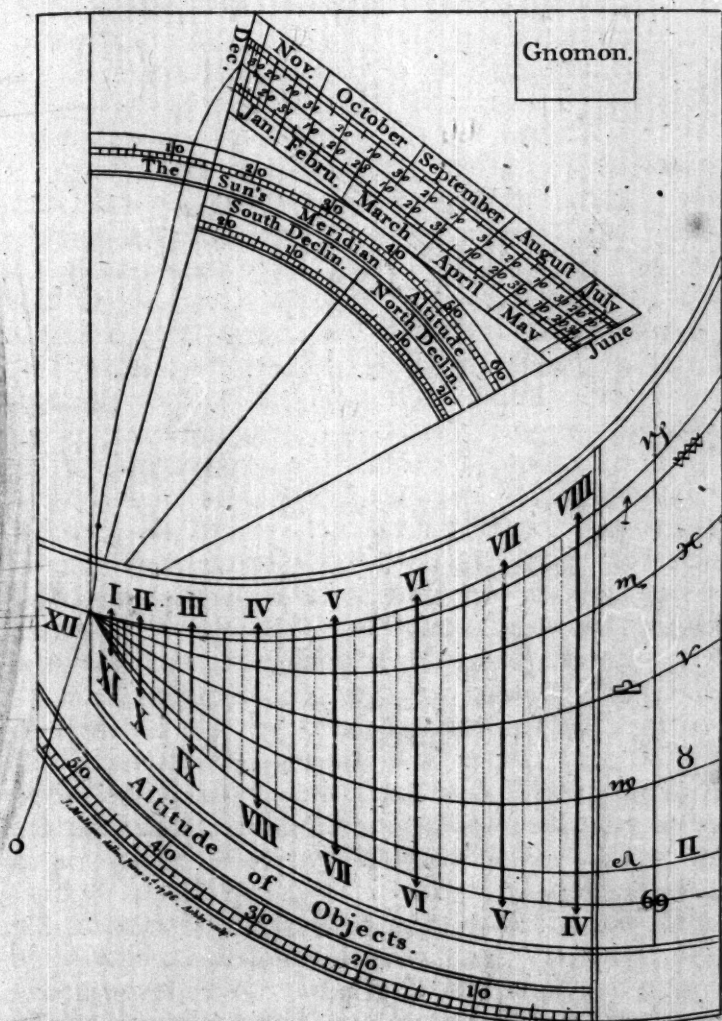
year,

year, and therefore unwilling to incur an unnecessary expence, such a substitute as we have here given must be very acceptable; particularly as no other work of the kind contains any thing like it, nor possibly can comprehend any plan of so useful an instrument for many years. The exercise it will afford to the young student, assisted by the directions here given, must prove at once extremely useful and pleasing.

The plate annexed of this very elegant little dial merits the attention of all our readers, both for its easy construction and abundant uses. We shall endeavour to explain them both, in a manner adequate to the most common capacity; at least to those who know any thing of the nature of an angle, and can take it in the compasses from a sector, or mark it off on the circular edge of a good protractor or semicircle.

The line of months is thus to be laid down. At a convenient distance from the margin, as at XII for a center, draw a line for the horizon, and set off an angle equal to the complement of the latitude of the place. This (for London) is $38^{\circ} 28'$. Apply the semicircle, with its center in XII, and the diameter on the bounding line of the angle, and mark off, each way from the extremity of such diameter, every degree of declination to $23^{\circ} 28'$, the greatest declination. Draw lines through these extreme points from XII, which shall be the limits within which the line of months must be projected; which line must be equally distant from the end of the line of the complement of latitude; and at right angles with it. Then to divide the said line, apply the semicircle to the said bounding line, with the center in XII, and from an ephemeris, or any good almanack, mark off the degrees and minutes of declination at the end of each month, also at every 10 and 20 days of the month, and also subdivisions at every five days; through which points lay a ruler from XII, and transfer them to the respective places, above or below the line of months, to other lines drawn parallel to the middle line. In this manner may the line of months be completed for any latitude, as may be seen in the figure.

The



USE. Having cut the middle black Line amongst the Months very nicely, put a Silk Thread through it, fasten it behind, and put a Bead on to move, with a larger one at the End to Stretch the Line. Move the Thread to the Day of the Month, and the Bead to XII, and it will cut the Sun's Meridian Altitude and the Declination, and by turning the Dial upright, the Line, if left at liberty, will shew at what time the Sun rises and Sets that Day, and the Bead will shew the Parallel of the Sun's Place. To find the Hour, raise the Gnomon & hold the Dial so that the upper Edge may shade the upper Line of the Dial exactly, & the Bead at liberty below will strike the Line of the Hour either Morning or Afternoon. The Altitude of any Object may be taken by two Gnomons.

The arch of declination, as already observed, is set off each way from the extreme part of the bounding line, or line of no declination.

The arch of the Sun's meridian altitude is also set off from the horizon, the limits of which must always be equal to the sum of the greatest declination added to the complement of latitude.

The arches for finding the Sun's place are thus drawn. Observe, as before, what degrees and minutes of declination the Sun has at the entrance of each sign, which mark on the circular edge of your instrument, the diameter being laid on the bounding line of no declination, and the center in XII, which transfer to the middle line of months; in which as centers, in such middle line, with the compasses always opened to XII, sweep the respective arches, the ends of which are to be marked with the signs accordingly.

The hour lines, for finding the time of the day, are thus drawn. From the point where the line of no declination meets the line of months, draw an obscure line parallel to the horizontal line drawn from XII, drawing it full across the arches of the Sun's place; this shall be the VI o'clock line, to which at right angles from the point XII, draw an obscure line, which shall be the radius of a semicircle for drawing the other hour lines, half hours, and quarters. With one point of the compasses in this VI o'clock line, strike an obscure semicircular arch from XII, or so much of it as is necessary; divide the said arch from the obscure part of that VI o'clock line to XII into 90 degrees (as it will always be a quadrant) and at every 15° let down a parallel line for the hours, at $7^{\circ} 30'$ for the half hours, and at $3^{\circ} 45'$ for the quarters. This is done each way from VI, the limiting point on the right hand being determined by the parallel line drawn from the extreme point in the middle line of months.

The arch of altitudes is drawn by making the extreme point just mentioned a center; and extending the compasses beyond the arches of the Sun's place at pleasure, sweep the arches, which graduate by means of a sector or other instrument, as you see in the plate.

Lastly,

Lastly, mark out the gnomon, as is seen in the figure, cutting out the top, bottom, and left side, when preparing for use. Also, cut through the middle line of months for a silk thread to slide through, on which a small bead is to be put, with a plummet at the end.

The dial being thus constructed, if you wish to know the time of the Sun's rising and setting, move the thread to the day of the month and lay it on its proper parallel; when the hour and parts of an hour of the Sun's rising will be seen in the lower class of figures, and of his setting in the upper, and by doubling the time of the Sun's setting, you have the time of the Sun's being above the horizon.

The thread being put to the day of the month, and laid to the center at XII, the degrees of the Sun's declination, whether north or south, will be cut in its proper arch, and also the meridian altitude at the same time in the place for which the dial is made.

The Sun's place is also known nearly by putting the bead to XII, and suffering it to play freely among the arches, till it reaches the extreme ends, which discovers the sign and part of the sign the sun is then in; for if the upper line of months gives the time, the sign is given in the left-hand column, but if the lower, it is had in the right-hand column.

The hour of the day is thus known, the thread being first moved to the day of the month. Raise the gnomon so as to cast a shadow when the edge of the right side of the dial is turned towards the Sun. Then move the bead to XII, and hold up the dial that it may play freely on the face; and when the shade of the upper edge of the gnomon exactly strikes the boundary line at the top of the dial, mark the place of the bead, which, for greater certainty, you may hold with the left thumb. That parallel on which the bead then is will give the hour; if before XII in the lower arch, but if after XII in the upper arch. For instance, let us suppose it was desired to know the hour in the morning of the 10th of May; having fixed the thread to the day of the month, hold up the dial in your left hand, by turning your right towards the Sun, and the bead and gnomon being disposed as directed, we will suppose the
bead

bead to fall on the dotted parallel next after IX, which will give the time 15 minutes after IX for the hour. Thus you may proceed for any other hour.

N. B. It is best to take the hour by this dial before X in the morning, or later than II in the afternoon, if you wish to know the time very nearly; for as the distances of the hours depend upon the variation of the Sun's altitude, and as that variation is least when he is near the meridian, the distances are proportional. But for general purposes, the hour may be known sufficiently near the truth any part of the day.

The altitude of any building, tree, &c. may be obtained in like manner, by means of the arch of altitudes. Then, having moved the thread to the longest day, the center upon which the arch of altitudes is struck, let the thread play freely, and at the distance of 20, 30, or 40 feet, or more, from the foot of the object, look along the upper boundary line by the top of the gnomon, and observe what degree is cut by the thread in that arch. Then look in the table annexed against that degree, and under the distance from the object is the height above the eye.

Thus, if at the distance of 20 feet from the lower end of a May-pole, you look along the bounding line, or the top of the gnomons (cutting out another gnomon, like the first, at the upper left-hand corner, for this purpose only), and the thread cuts the arch of altitudes at 52° , to find the May-pole's height. Against 52° , under 20 at the top, is 25.60 for the height above the eye; and supposing the eye to be 5 feet from the ground, the height of the May-pole will be 30 feet and little more than a half from the ground.

A TABLE

A TABLE of ALTITUDES included
within different Angles at several Distances, to find
out the Height of Buildings, Trees, &c.

Deg.	20	30	40	50	60	70	80
10	3.52	5.29	7.05	8.81	10.58	12.34	14.10
11	3.98	5.83	7.77	9.72	11.66	13.60	15.55
12	4.25	6.37	8.50	10.63	12.75	14.88	17.00
13	4.61	6.92	9.23	11.54	13.85	16.16	18.47
14	4.98	7.48	9.97	12.46	14.96	17.45	19.94
15	5.36	8.04	10.72	13.39	16.07	18.75	21.43
16	5.73	8.60	11.47	14.33	17.20	20.07	22.94
17	6.11	9.17	12.23	15.28	18.34	21.40	24.46
18	6.50	9.75	12.99	16.24	19.49	22.74	25.99
19	6.88	10.33	13.77	17.21	20.66	24.10	27.54
20	7.38	10.92	14.56	18.20	21.84	25.48	29.11
21	7.67	11.51	15.35	19.19	23.03	26.87	30.71
22	8.08	12.12	16.16	20.20	24.24	28.28	32.32
23	8.49	12.73	16.98	21.22	25.47	29.71	33.96
24	8.90	13.35	17.81	22.26	26.71	31.16	35.62
25	9.32	13.99	18.65	23.31	27.98	32.64	37.30
26	9.75	14.63	19.51	24.38	29.26	34.14	39.02
27	10.19	15.28	20.38	25.47	30.57	35.66	40.76
28	10.63	15.95	21.27	26.58	31.90	37.22	42.53
29	11.08	16.63	22.17	27.71	33.26	38.80	44.34
30	11.54	17.32	23.09	28.86	34.64	40.41	46.19
31	12.01	18.02	24.03	30.04	36.05	42.06	48.07
32	12.49	18.74	24.99	31.24	37.49	43.74	49.99
33	12.99	19.48	25.97	32.47	38.96	45.46	51.95
34	13.49	20.23	26.98	33.72	40.47	47.21	53.96
35	14.00	21.00	28.01	35.01	42.01	49.01	56.01
36	14.53	21.79	29.06	36.32	43.59	50.86	58.12
37	15.07	22.60	30.14	37.68	45.21	52.75	60.28
38	15.62	23.44	31.25	39.06	46.87	54.69	62.50
39	16.19	24.29	32.39	40.49	48.58	56.68	64.78
40	16.78	25.17	33.56	41.95	50.34	58.73	67.13
41	17.38	26.08	34.77	43.46	52.15	60.85	69.54
42	18.01	27.01	36.01	45.02	54.02	63.03	72.03
43	18.65	27.97	37.30	46.62	55.95	65.27	74.60
44	19.31	28.97	38.62	48.28	57.94	67.60	77.25
45	20.00	30.00	40.00	50.00	60.00	70.00	80.00
46	20.71	31.06	41.43	51.77	62.13	72.48	82.84
47	21.44	32.17	42.89	53.62	64.34	75.06	85.79
48	22.21	33.32	44.42	55.53	66.63	77.74	88.85
49	23.00	34.51	46.01	57.52	69.02	80.52	92.03
50	23.83	35.75	47.67	59.59	71.50	83.42	95.34
51	24.70	37.04	49.39	61.74	74.09	86.44	98.79
52	25.60	38.40	51.19	63.99	76.79	89.59	102.39
53	26.54	39.81	53.08	66.35	79.62	92.89	106.16
54	27.52	41.29	55.05	68.82	82.58	96.34	110.11

*Of Painting DIAL BOARDS,
and Colouring MAPS.*

HAVING, in our Geographical Lessons, referred to this place for colouring Maps, it seems proper to introduce it with the best method of colouring Dial Boards.

The clearest oak, and the reddest fir, if it be free from turpentine, are most proper for making dial-boards; which should be well dried, after being jointed and planed on both sides, though ever so old or dry before. Then shoot them again with good joints, which secure with two dove-tails let in behind, after the boards are glued together and well dried. Fit the edges into the rabbet of a moulding, as the pannel of a wainscot in its frame, that it may not be improperly affected by changes of weather.

Half a pound of the best glue, boiled gently in a quart of water till it is thoroughly dissolved, so as neither to be too thin or too thick, will make it good; use it thoroughly hot, with expedition, sliding the faces of the joints two or three times, to settle them close, and so let them stand till they are firm and dry.

Colours for painting the board are Spanish brown for the priming, white lead for the second colour, vermilion for drawing the hour lines, and lamp black for the figures in the margin. But to gild the dial, and the figures, gold and gold size, with smalt for a blue ground (if you intend a rich colour) must be used; or a black ground with gold figures will look very well.

Then the draught being prepared, as by the rules given already, for a south, east, or west dial, prime your dial with Spanish brown well ground, and mixed somewhat thin, on both sides; and when dry, repeat it somewhat thicker, and again, when dry, still thicker if you please. Do the same three or four times with white lead tempered with linseed oil. Then, with a black-lead pencil, draw an horizontal line at a proper distance from the upper edge, and set out the margin

At h

with

with boundary lines for the hours, half hours, and quarters, according to your plan or draught. When all the lines are transferred from the draught to the dial board, draw the boundary lines, with the hour, half hour, and quarter divisions, with well ground vermillion, as thick as it can be worked smooth; and the figures for the hours, with the dot at the half hours, with lamp black. The date of the year, or any name or sentence, may also be put at the top of the margin; and the gnomon being fixed properly, it will then be ready to be put in its place.

For any kind of gilding, a size made of drying oil, with yellow oker, ground as fine as the oil itself, is necessary. The drying oil is made by boiling about two ounces of litharge (which may be had at any drug-gift's or colour-shop), finely powdered, in a quart of linseed oil, near half an hour, in an earthen pan, till it is quite thick and fat. Then set it on fire a little, stirring it well; put out the flame by covering it with any thing close, and when it is cold pour off the clear oil, which keep for use in a bladder close tied up, or in a glass bottle. With this size draw the figures, letters, &c. you would gild, and when it is just dry enough to stick a little, without taking off the colour, lay on the gold, cut nearly of the shape wanted on your gilding cushion; breathe gently upon it, and it will lay smooth. Then blow gently on your gilding pallet, and lay the gold upon it, transferring it to the size, where it will stick; press it smooth with cotton, and having finished your gilding, piece by piece, brush off all the loose gold, as soon as it is thoroughly dry, and the work will appear fair and beautiful.

Colours, &c. for Maps.

For colouring maps, an amusement both extremely agreeable and of great advantage, besides the colours, gum water and tartar ley are principally requisite.

GUM WATER may be made in this proportion. Three ounces of the whitest and clearest gum arabic,
beat

beat small, may be dissolved in a pint of fair spring water: shake it two or three times a day very well. If there is any foulness in it, strain it through a rag into a clean earthen dish, and then bottle it for use. It should be made fresh every two months; therefore small quantities are best at once.

TARTAR LEY is made in this manner. Wrap about two ounces of the best white tartar very tight in half a sheet of brown cap paper, thoroughly wet; put it into a clear fire of wood or sea coal, to remain till it is red hot, when it must be taken out with the tongs, and immediately put in a pint of water. Rub it well to pieces with your fingers, and put all into a long, narrow glass; in a day or two the clear ley may be decanted off, and, when put into a clean glass, kept for use.

COLOURS of a superior brightness and lustre are made as follows, peculiarly calculated for improving and embellishing maps.

A COPPER GREEN is thus made. Take a quantity of the best French verdigrease, which beat into fine powder, with about one-fifth of cream of tartar, avoiding the fumes of the verdigrease by stuffing the nose, and holding some fine linen in the mouth. Mix the powders in about five or six times their weight of water, which boil away in an earthen pipkin to half; and when cold, strain it, putting the liquor into a glass, which stop up, and let it stand to settle till the liquor is very clear. If it should not be deep enough, diminish it by a gentle heat over a few coals, and try its strength by a slip of white paper. But it should not shine too much; this will sometimes make it necessary to boil it anew with some more verdigrease, so as to become a transparent, deep willow green. This colour will keep many years, if close corked. A little quantity may be made in a small pot or cup over a few hot embers.

A STONE-COLOUR is made by boiling an ounce of the best myrrh, in powder, in a pint of the tartar ley,

ley, till it is dissolved. A short time will do it; pour off the clear liquor, when settled, for use, keeping it close stopped. It will never decay: boil away the liquor to make it deeper, or add water to make it fainter.

A CRIMSON COLOUR may be made with about 30 or 40 grains of good cochineal, bruised to fine powder in a gally pot, adding as many drops of tartar ley as will just wet it, and force the colour. Put half a spoonful of water to it immediately, or more, if it is too deep; you will have a delicate PURPLE COLOUR or Tincture. Scrape a very little allum into the tincture, and it will change into a delicate Crimson; it should be used soon, as it decays with keeping.

For a BLUE, grind indigo very fine on a stone, with a little tartar ley; and when like a thick syrup, add gum water to it, and keep it in a glass close stopped. When you use it, stir it up from the bottom.

Gamboge makes the best YELLOW, in a lump of which make a hole with a penknife to put in some water; stir it well with a pencil, to make a faint or deeper yellow as you require. Pour it into a gally pot, and temper more till you have enough.

Red lead and orpiment may be had at the shops very finely ground, which temper with gum water for use. Blue bice needs only to be tempered in the same manner. Ultramarine, though dear, will go a great way with care, and may be mixed with a little gum water in a very small gally pot.

Carmine is a very dear colour, but may be tempered to various degrees of crimson with gum water, and should be used with care. Vermillion is a beautiful scarlet, if so tempered; but it shews much brighter when dry, if glazed over with some thick gum water, in proportion of two ounces of gum arabic to half a pint of water, or less.

Burned umber, for some uses, if ground very fine, and thick as possible, and then tempered with gum water

water to a proper thickness, makes a good transparent colour. A pleasant GRASS GREEN is made by taking a lump of gamboge (as for yellow) and mixing in it some copper green; by stirring it with a pencil, it will change from a willow to a grass green, and will be deeper or lighter, according to the time you stir it.

To Colour the Maps.

The divisions in a map, which distinguish one kingdom from another, or one county from another, are known by certain lines or rows of pricks, or points of several sizes and shapes, agreeable to the divisions they are to denote. In a map of *Spain* and *Portugal*, for instance, the two kingdoms are separated by a row of large points or pricks, and the several provinces (such as we call shires in *England*) are distinguished by lines of lesser points. Then, to colour *Portugal*, cover the hills within the large pricked line with very thin tincture of myrrh, or tincture of Jesuit's bark; and, where there are woods, dab every tree with the point of a very fine pencil dipped in grass green, made with gamboge and copper green. In dipping your pencil, stroke it against the side of the pot or glass where your colour is, to prevent its dropping. The principal cities and towns may be marked with another pencil dipped in red lead, thinly tempered with gum water, that the eye may readily perceive them.

To trace out the bounds of the provinces, take another pencil dipped in copper green, which move along the inside of the pricked lines, laying it evenly on. The next province may be coloured in like manner with gamboge, the next with the crimson tincture of cochineal, the next with red lead, the next with grass green, and then any of the former colours. Observe, that no two provinces must in any part join with the same colour; and that where the provinces join, the second colour must not be laid on before the first be dry. The colours may be lightened off, or made fainter, when nearly dry, by wetting a clean

pencil in water, gently squeezing it out, and going round with it on the inside of the coloured line.

Note, That where any towns, trees, hills, &c. have been coloured before the bounds are marked out, those places must continue, and not be coloured again with any other tincture or colour. Landscapes may be coloured according to nature, as may all other devices or figures which are introduced to set off and embellish maps. Our limits will not allow us to be more particular; and therefore we shall only add in general, that the water and the bottoms of ships are to be tinged with thin indigo, the hull with umber, the sails with tincture of myrrh, and the flags with vermillion or blue bice, according to their respective colours. The smoke of the guns may, where necessary, be done with very thin bice; and lastly, the border or margin of the map may be coloured either with yellow, red, crimson, or any other lively colour at pleasure.

Of MEASURING.

MANY considerable uses of this branch of learning have been already mentioned in the application of Duodecimals to artificers works, with specimens of board and timber measure. The Young Measurer's Complete Guide, by the late Mr. Fenning, has been also referred to for further information. Our limits oblige us to be very concise, and therefore I shall briefly shew the nature of a few plain figures, preparatory to Surveying and Gauging, in order to shorten the observations on those useful practical subjects.

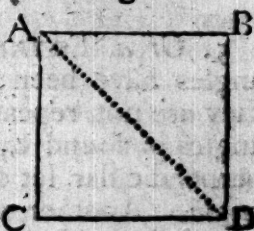
The principal figures in superficial measuring are squares or other four-sided figures, triangles or three-sided figures, with circles or their parts, and the ellipsis. Those in solid measuring are cubes or other six-sided figures, prisms, pyramids, spheres, and other circular solids.

Of

Of superficial Figures, and how to find their Area.

1. *Of a SQUARE.* This is a figure of four equal sides, at right angles with each other, the nature of which has been explained in the entrance upon Geometry, as the Figure $A B C D$, Fig. 1. Its content is found by multiplying the side into itself.

Fig. 1.



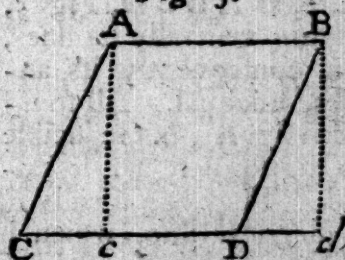
2. *Of a PARALLELOGRAM.* This figure also consists of four sides, and at right angles with one another, but the opposite sides only are equal, as $a b c d$, Fig. 2. The length $a b$ multiplied by the breadth $a c$ will give the area.

Fig. 2.



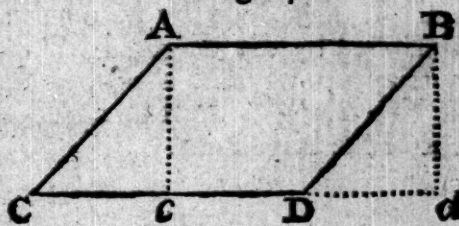
3. *Of a RHOMBUS.* As this figure has also four equal sides, it differs from a square that none of its angles are right angles, but two obtuse and two acute. Its shape is that of a diamond pane of glass, as the Figure $A B C D$, Fig. 3; and its content is found by multiplying the side of the rhombus $A B$ into the perpendicular $A c$ let fall from the obtuse angle at A .

Fig. 3.



4. *Of a RHOMBOIDES.* Its sides are like those of the parallelogram, from which it differs as the rhombus does from the

Fig. 4.

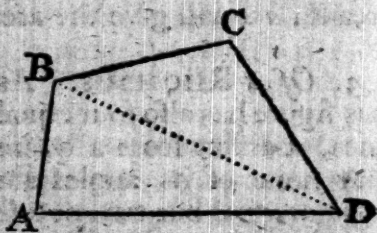


square,

square, having two obtuse and two acute angles. Its content is also found by multiplying the longest side AB (see Fig. 4) into the perpendicular Ac let fall from the obtuse angle at A .

5. *Of a TRIANGLE.* As the several kinds of triangles have been given under Plain Trigonometry, they are not repeated. The content of all plain triangles is found by multiplying any side into half the perpendicular let fall upon that side from the opposite angle. Another method of importance to be known, especially by surveyors of land, as every possible cause of error in taking a perpendicular is precluded, is as follows: add the three sides together, and from half the sum subtract each side singly, noting the remainders, which being multiplied continually into each other with the said half sum, and the square root of the product extracted, the content is obtained.

Fig. 5.



6. *Of a TRAPEZIUM.*

This is a four-sided figure, as $ABCD$, Fig. 5, having generally its sides, and consequently its angles, unequal. All four-sided figures, not reducible to the former, are so called.

They are usually divided into two triangles by a diagonal line, which is a common base to both, as BD , which is one side of the triangle BCD , as it is also of the triangle ABD . It may be measured either by perpendiculars let fall from C and A respectively on the common base or diagonal BD , or singly by the preceding rule for a triangle without the perpendiculars. If it is done by perpendiculars, half their sum multiplied by the diagonal will be the content; but if by triangles without a perpendicular, the content of the two triangles must be added together for the content of the trapezium.

7. *Of*

Fig. 6.

7. *Of POLYGONS.* Regular Polygons consist usually of a number of equal sides, from five to twelve, and may be considered as making so many isosceles triangles, of which the side is the base, and the center of the circle on which the polygon is drawn is the opposite angle. Thus *ABCDEF*,

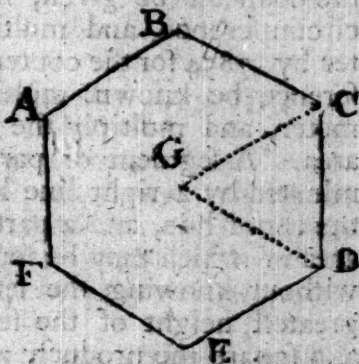


Fig. 6, is a hexagon or regular polygon of six sides, of which *CDG* represents one of the triangles; so that if the content of one triangle be found, that content multiplied by the number of sides gives the content of the whole.

Fig. 7.

Irregular Polygons have their sides and angles unequal, as *ABCDE*, Fig. 7, is an irregular figure of five sides, the content of which is found by drawing diagonal lines, and proceeding as directed for triangles and trapezia.

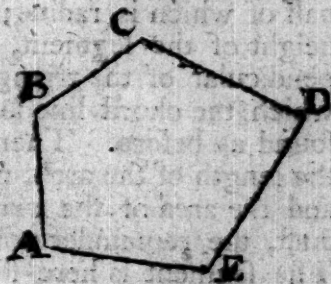
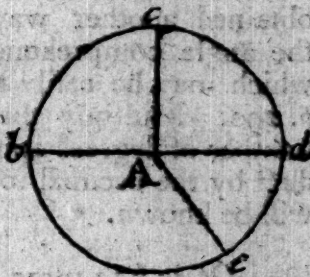


Fig. 8.

8. *Of a CIRCLE and its PARTS.* A Circle is a figure perfectly round, and is formed by the motion of any straight line, as *Ad*, moving round one end of it, as *A*, the center of the circle *b o d e*, Fig. 8, of which *b A d* is called the diameter, passing from one side of the circle to the other through the center. The most



general properties of circles are, to find the circumference and area, having the diameter, or to find the diameter

diameter and area, having the circumference given. If the diameter be given, multiply it by 3.1416 for the circumference, and multiply the square of the diameter by .7854 for the content or area; but if the circumference be known, multiply it by .3183 for the diameter, and multiply the square of it by .0795 for the area. A segment or part of a circle is a figure terminated by a right line less than the diameter, called the chord line, and a part of the circumference; the area of which may be found sufficiently near the truth without knowing the semi-diameter. Multiply the greatest height of the segment by the number .626, and square the product, and to this add the square of half the chord line; twice the square root of that sum multiplied by two-thirds of the height will give the area or content. But, to be more exact, proceed thus. Square half the chord line, which divide by the greatest height of the segment, and the quotient added to such greatest height will give the diameter of the circle, half of which is radius; from this subtract the greatest height of the segment, and the remainder is the perpendicular of the triangle, bounding such segment, of which the chord line is the base, the area of which is found as before. Then if radius be multiplied by half the length of the arch, measured on the circumference, and the area of the triangle be taken from that product, the remainder will be the area of the segment. The segment is here supposed to be less than a semi-circle.

Or the area of the segment of a circle may be obtained another way, by finding the radius, and the angle comprehending the area of such segment, which may be easily had by Prob. VI. in Geometry, p. 290. Multiply the square of such radius by the number of degrees contained in the area, and that product by the decimal .0087267, and the area or content will be known.

9. *Of an ELLIPSIS or OVAL.* The various ways of making an oval have been shewn under Prob. VIII. of Geometry, p. 291, &c. and the best method of finding their content is, to multiply the length by the breadth, and

and that product by .7854. So much for superficial figures.

To find the Content of Solid Figures.

1. *Of the CUBE.* This is a square solid, compounded of six geometrical squares, and exactly in the shape of a dye, the figure of which is well known. Its content is found by multiplying the square of its side into the side, and the last product is the answer.

2. *Of the PARALLELOPIPEDON.* This is a solid figure, compounded of six parallelograms, the opposite sides of which are equal. Or it may be called a prism, the base or end of which is a parallelogram, and may represent a piece of timber or stone. As the length at the end multiplied by the breadth gives the area of a parallelogram, or the base, so that product by the whole length gives the solid content of the piece.

3. *Of the PRISM.* Though a parallelopipedon may be deemed a prism, yet those are generally considered to be such only as have a polygon for their base, including the triangle and square. In all prisms, whether triangular, square, pentagonal, hexagonal, &c. the area of the base multiplied by the length will be the solid content. — *N. B.* All the dimensions must be of the same name or denomination, in this and the following solid bodies, or reduced to the same. If they are all inches, divide the product by 1728 for solid feet. But if the length is in feet, and the other dimensions in inches, the length may be multiplied in feet, and the product divided by 144 for solid feet. This observation holds good of the following figures.

4. *Of the PYRAMID.* These are of various sorts, and are named as their bases; all gradually diminishing to the top, where the several sides terminate in a point. They are called triangular, square, pentagonal, &c. and are generally, though not always, polygonal. The area of the base, whatever form they are of, multiplied
by

by one-third of the perpendicular height, will give the content.

5. *Of the FRUSTUMS of PYRAMIDS.* These are as various as the several pyramids, and are such as do not terminate in a point, but seem to be cut off at some intermediate place. Such are many kinds of obelisks, which are only continued to a certain height, gradually diminishing from the base; on which statues or other figures are frequently erected. To find their content, add the square of the side of the greater base to the square of the side of the lesser base, and also the rectangle of those sides. Multiply the sum, if the base is a triangle, by .433; if a square, by 1; if a pentagon, by 1.7204; if an hexagon, by 2.598, &c. as given at p. 244 of the *Young Man's Book of Knowledge*, by Mr. Fenning, last edition. That product multiplied by one-third of the height gives the content.

6. *Of a CYLINDER.* This is only a round column, the bases being equal circles, and is exactly represented by a garden or field roller. The area of the circle at the base multiplied by the height will be the content.

7. *Of a CONE.* This is of the nature of a pyramid, but circular, and, like that, ends in a point. The content is found by multiplying the area of the base by one-third of the height.

8. *Of the FRUSTUM of a CONE.* This is also of the nature of the Frustum of a Pyramid, when the upper part of the cone seems to be cut off before it terminates in a point; of this sort are many obelisks, columns in buildings, &c. The method of finding the content is somewhat similar to that for the frustums of pyramids, which is, by adding the square of the diameter at each end to the rectangle of the two diameters, and multiplying the sum by .7854, and that product by one-third of the height.

9. *Of*

9. *Of a SPHERE or GLOBE.* This is known to be a round solid body, which is exactly represented by a ball. There are different rules for finding its solid content. Multiply the cube of the axis or diameter by .5236, and the product will be the content. Or, multiply the circumference by the axis, and the product will be the superficial content, which also multiply by the axis, and the sixth part of the product is the content. Other rules are sometimes given, but they are not strictly true.

10. *Of the SPHEROID.* This is nearly of the shape of an egg, each end of which is equally convex or full. It may be conceived to be formed by the revolution of an oval or ellipsis about its transverse or longest diameter. The content is found by multiplying the square of the breadth or conjugate diameter into the length or transverse diameter, and that product by .5236.

For the regular Solids, see *the whole Art of Measuring, or the Young Measurer's Complete Guide*, by D. Fenning.

Of SURVEYING.

THIS is an art so immediately depending upon Geometry and the Rules for Measuring just laid down, that I have assigned this place as most proper for treating it. Its utility is too well known to be commented upon. The gentleman, of course, wishes to know the quantity of acres his estate consists of, and the farmer the admeasurement of his different fields. Without some knowledge of the art of land-measuring, he can neither set out his acre of wheat for the reaper, or his turnips for the labourer he employs to hoe them.

It is my intention to assist my readers in this matter, by shewing a plain, easy method of finding the content of any piece of ground, of whatever form. For this purpose a gunter's chain, consisting of 100 links of an

equal length, is commonly employed, and is the most general instrument in use. This is 22 yards in length, and consequently every 25 links is equal to one pole, or five yards and a half. For common purposes this is sufficient. Nor indeed is this always necessary; for it is very easy to find the content of any piece of ground, by taking its dimensions in yards and parts of a yard. I shall shew the method of doing this both ways, first premising, that I suppose my reader to be acquainted at least with Division and Reduction, and in certain cases of triangles it would be proper to know the Square Root; though the necessity of this is not to be maintained, because it may be readily done another way, as will be seen presently.

The first thing to be considered is, to take the dimensions, as it is commonly called, *i. e.* the measure in length of such sides of the field or part of a field as are necessary; or the diagonals where the sides are not regular, which it must be observed very few fields are. If the length on one side is equal to the length on the other side, and the breadth at both ends also equal, then the content in the denominations you measured in is had, by multiplying the length and breadth together as in a parallelogram; so that if you measured by links, this product will be square links, which being divided by 100000 (the number of square links in an acre) the quotient will be acres. N. B. This is done by cutting off five places of figures on the right hand, and to find the value of the remainder, or figures so cut off, multiply them by 4, and cut off also five places, and if any figure be on the left hand it will be roods; multiply those again on the right, if any, by 40, and cut off as before for perches.

If in the instance already mentioned, the dimensions were taken in yards by a line or string, afterwards measured by a yard measure, then such product would have been square yards; and if this was divided by 4840 (the number of square yards in an acre) the quotient would be acres. The remainder, if any, multiplied by 4, and divided by 4840, gives the roods; and that remainder multiplied by 40, and the product divided by 4840 as before, gives the perches.

Example

UNIVERSAL COMPANION. 363

Example 1. A piece of ground was measured, the length of which was 500 links, or 5 chains, and the breadth 200 links, or 2 chains; what is the content?

OPERATION.

$$\begin{array}{r} 500 \\ 200 \\ \hline 100000 \end{array}$$

The length and breadth are here multiplied together, and 5 places to the right hand cut off, as by the rule, and the figure on the left hand shews the content to be just one acre.

Example 2. A farmer agrees with a reaper to cut a piece of wheat, the length of which was 110 yards, and the breadth 44 yards; and being desirous of knowing the quantity of ground it contains, is here requested?

OPERATION.

$$\begin{array}{r} 110 \\ 44 \\ \hline 440 \\ 440 \\ \hline \end{array}$$

4840)4840(1 Acre, *Ans.*

$$\begin{array}{r} 4840 \\ \hline \end{array}$$

Example 3. A farmer has a small three-sided field of the shape of a triangle, the three sides of which measure 150 yards, 136 yards, and 120 yards; the content is here desired to be known?

150	203	203	203
136	150	136	120
120			
2)406	53	67	83

$$\begin{array}{r} 203 \\ 53 \\ \hline \end{array}$$

$$\begin{array}{r} 609 \\ 1015 \\ \hline \end{array}$$

$$\begin{array}{r} 10759 \\ 67 \\ \hline \end{array}$$

$$\begin{array}{r} 75313 \\ 64554 \\ \hline \end{array}$$

$$\begin{array}{r} 720853 \\ 83 \\ \hline \end{array}$$

$$\begin{array}{r} 2162559 \\ 5766824 \\ \hline \end{array}$$

59830799(7735 *Square Yards*, which divided by 49

$$\begin{array}{r} 147)1083 \\ 1029 \\ \hline \end{array}$$

$$\begin{array}{r} 1543)5407 \\ 4629 \\ \hline \end{array}$$

$$\begin{array}{r} 15465)77899 \\ 77325 \\ \hline \end{array}$$

$$\begin{array}{r} 574 \\ \hline \end{array}$$

4840, the square yards in an acre, and reduced as above directed, will give 1 *Acre*, 2 *Roods*, and 16 *Perches* nearly.

If

If upon the longest side a perpendicular be taken from the opposite angle, by means of a cross staff or quadrant staff, it will strike the angle opposite the base, at 80 yards from the extremity of the greatest side subtending such angle, or at 64 yards from the extremity of the lesser side. Then measure the perpendicular, which is 103 yards, which multiplied into half the base will give the content nearly as above.

In the same manner the area of irregular four-sided figures, called Trapezia, must be found; or any other number of sides, however irregular, by measuring diagonals, and making them the bases of triangles. Or, for trapezia, by measuring the diagonals and taking perpendiculars, half the sum of the perpendiculars multiplied by the diagonal gives the content.

Example 4. An irregular four-sided field was to be measured, the diagonal of which was found to be 325 yards, and the perpendiculars (the nearest distance from the angles being obtained by the cross or quadrant staff) 230 and 194 yards; what is the content?

$$\begin{array}{r}
 230 \\
 194 \\
 \hline
 2)424 \\
 \underline{212} \\
 325 \\
 \hline
 1060 \\
 424 \\
 \hline
 636 \\
 4840)68900 \text{ (14 Acres.} \\
 \underline{4840} \\
 20500 \\
 \underline{19360} \\
 1140 \\
 \underline{4} \\
 4560 \\
 \underline{40} \\
 4840)182400 \text{ (37 Perches.} \\
 \underline{14520} \\
 37200 \\
 \underline{33880} \\
 3320
 \end{array}$$

In the same manner may be found the content of any field whatever. If the above field had been measured with the chain, the dimensions would have been nearly these, viz. the diagonal, 14 chains, 77 links; and the two perpendiculars, 10 chains, 46 links, and 8 chains, 82 links; and the operation as follows:

Ch.	Lin.
	10.46
	8.82
2)	19.28
	9.64
	14.77
	6748
	6748
	3856
	964
14	2.3828
	4
	95312
	40
38	12480

Note, It frequently happens that one side of a field may be an old boundary fence, or some brook, &c. may occasion such side to be very irregular; in such case, in taking the dimensions, take a straight line as much within the limits of the field as possible, and calculate as before. For those irregularities, take offsets to the amount of 8 or 10, and sometimes 15 or 20, or more, as occasion seems to require, the sum of all which being divided by the number of offsets taken, will give a mean distance to be multiplied by the direct length of the line or side, to be added to the former for the whole content.

Here follow two tables for laying out an acre of ground by yards, of great use to many, and for converting yards into chains and links, or the contrary.

TABLE

UNIVERSAL COMPANION. 367

T A B L E I.

The Length in Yards and Inches required to make an Acre, according to any Number of Yards proposed in Breadth.

Breadth in Yds.	Length.		Breadth in Yds.	Length.	
	Yards.	Inches.		Yards.	Inches.
1	4840	00	36	134	16
2	2420	00	37	130	29
3	1613	12	38	127	13
4	1210	00	39	124	04
5	968	00	40	121	00
6	806	24	41	118	02
7	691	15	42	115	09
8	605	00	43	112	20
9	537	28	44	110	00
10	484	00	45	107	20
11	440	00	46	105	08
12	403	12	47	102	35
13	372	11	48	100	30
14	345	26	49	98	28
15	322	24	50	96	29
16	302	18	51	94	32
17	284	25	52	93	03
18	268	32	53	91	12
19	254	27	54	89	23
20	242	00	55	88	00
21	230	17	56	86	15
22	220	00	57	84	33
23	210	16	58	83	16
24	201	24	59	82	01
25	193	22	60	80	24
26	186	05	61	79	12
27	179	09	62	78	02
28	172	31	63	76	30
29	166	32	64	75	22
30	161	12	65	74	17
31	156	05	66	73	12
32	151	09	67	72	08
33	146	24	68	71	06
34	142	12	69	70	05
35	138	10	70	69	05

T A B L E II.

The Number of Acres, Square Chains, and Parts of a Chain, each Chain being divided into 121 Parts, contained in any Number of Square Yards.

Square Yards.	Square Chains.	Parts.	Square Yds.	Square Chains.
1	20	80	4840	1,00000
2	41	39	9680	2,00000
3	61	119	14520	3,00000
4	82	78	19360	4,00000
5	103	37	24200	5,00000
6	123	117	29040	6,00000
7	144	76	33880	7,00000
8	165	35	38720	8,00000
9	185	115	43560	9,00000
10	206	74	48400	10,00000
20	413	27	96800	20,00000
30	619	101	145200	30,00000
40	826	54	193600	40,00000
50	1033	07	242000	50,00000
60	1239	81	290400	60,00000
70	1446	34	338800	70,00000
80	1652	108	387200	80,00000
90	1859	61	435600	90,00000
100	2066	14	484000	100,00000
200	4132	28	968000	200,00000
300	6198	42	1452000	300,00000
400	8264	56	1936000	400,00000
500	10330	70	2420000	500,00000
600	12396	84	2904000	600,00000
700	14462	98	3388000	700,00000
800	16528	112	3872000	800,00000
900	18595	05	4356000	900,00000
1000	20661	19	4840000	1000,00000
2000	41322	38		
3000	61983	57		
4000	82644	76		

The use of these tables is evident; for if you wish to measure out an acre of ground, the breadth of which shall be 45 yards, you have the length 107 yards and 20 inches by the first table. In like manner, the use of the second table is plain; by which the number of square chains or acres in any known number of square yards is obtained at sight, from one yard to 1000 acres, which may be continued to any number at pleasure. If the number cannot be taken out at once, extract it at twice, or at three or more times, if necessary, and add together. It has been noted already, that if five places of figures on the right hand are cut off, the figures on the left hand will from square chains become acres.

Of G A U G I N G.

OUR limits oblige us to be very brief in this branch of measuring. The same rules, therefore, shall suffice for computing measures of capacity, as for solid bodies of the same form already given. But there are some peculiar forms of vessels, such as casks, tuns, &c. which though they need no explanation as to their form, must be particularly considered.

For measuring casks, take the diameters at the head and bung, and also the length, in inches, and then proceed thus. Find the areas of the circle at the bung, and also at the head, separately, as taught under Measuring; and to two-thirds of the area at the bung add one third of the area at the head, which sum, multiplied by the internal length of the cask, will give the content of such cask in solid inches. Divide this by 231, if for wine gallons, or by 282, if for ale gallons; and the quotient will give the number of gallons in such cask.

Example. Suppose the bung diameter of a cask to be 31.5 inches, and each head diameter 24.5 inches, and the length 42 inches; to find the content of such cask in ale gallons?

First,

First, The square of the bung multiplied by .7854, gives 779.31315, two thirds of which is 519.5421 inches. *Secondly*, The square of the head multiplied by .7854, gives 471.43635, one third of which is 157.14545. *Thirdly*, Their sum, multiplied by 42, gives the capacity of the cask in inches, 28420.8771. *Lastly*, Divide this by 282, and the quotient is 100 gallons, and a little more than 3 quarts.

The reason of giving so distinct an account of the operation is, that by directing the young student to find the area of the respective head and bung circles, the propriety of such operation might be more clearly perceived. This being observed, we may naturally deduce from hence another general rule; which will not only render the multiplication by .7854 for reducing the square to its inscribed circle unnecessary in one case, but in both. For if to two-thirds of the square of the bung diameter, one-third of the square of the head diameter be added, and that sum being multiplied by the length, and the product divided by (what are usually called the circular divisors) 359.05 for ale gallons, and 294.12 for wine, the content will be had the same, as before. Or, that product may be multiplied at once by .7854, and divided by 282 and 231, which will give the same.

Note, If a round tun is to be gauged, let it be done as taught for a cylinder, if the top and bottom are equal; if they are unequal, take the method given for the frustum of a cone.

Here follows a table, by means of which, the dimensions and content of the whole cask being known, the liquor remaining in any cask may be known when part is drawn off. But this is only for casks which lay upon the bulge or side; though this is the most common way, except among large brewers, and therefore best calculated for general use.

A TABLE

UNIVERSAL COMPANION. 371

A TABLE for calculating the Contents of a Cask, when partly drawn off, sufficiently near for common Purposes.

V. S.	Segment	V. S.	Segment	V. S.	Segment	V. S.	Segment
1	0,0017	26	0,2066	51	0,5127	76	0,8155
2	0,0048	27	0,2178	52	0,5255	77	0,8263
3	0,0087	28	0,2292	53	0,5382	78	0,8369
4	0,0134	29	0,2407	54	0,5509	79	0,8473
5	0,0187	30	0,2522	55	0,5635	80	0,8576
6	0,0245	31	0,2640	56	0,5762	81	0,8677
7	0,0308	32	0,2759	57	0,5888	82	0,8776
8	0,0375	33	0,2878	58	0,6014	83	0,8873
9	0,0446	34	0,2998	59	0,6140	84	0,8967
10	0,0520	35	0,3119	60	0,6265	85	0,9059
11	0,0598	36	0,3241	61	0,6390	86	0,9149
12	0,0680	37	0,3363	62	0,6514	87	0,9236
13	0,0764	38	0,3486	63	0,6637	88	0,9320
14	0,0851	39	0,3610	64	0,6759	89	0,9402
15	0,0941	40	0,3735	65	0,6881	90	0,9480
16	0,1033	41	0,3860	66	0,7002	91	0,9554
17	0,1127	42	0,3986	67	0,7122	92	0,9625
18	0,1224	43	0,4112	68	0,7241	93	0,9692
19	0,1323	44	0,4238	69	0,7360	94	0,9755
20	0,1424	45	0,4365	70	0,7478	95	0,9813
21	0,1527	46	0,4491	71	0,7593	96	0,9866
22	0,1631	47	0,4618	72	0,7708	97	0,9913
23	0,1737	48	0,4745	73	0,7822	98	0,9952
24	0,1845	49	0,4873	74	0,7934	99	0,9983
25	0,1955	50	0,5000	75	0,8045	100	1,0000

USE of the TABLE. In the cask already given for an example, whose bung diameter is 31.5 inches, and the content 100.78 gallons, let 10 inches of the liquor be drawn off, so that the wet inches at the bung are 21.5 inches; what quantity of liquor is drawn off?

Rule.] Multiply the dry inches by 100, and divide the product by the diameter at the bung, and the quotient will be the number wherewith to enter the table. Then take out the number standing against it, which multiply

multiply by the content of the whole cask, cutting off from the product four figures on the right hand, when those on the left hand will be gallons. If there is any remainder in such right-hand figures, multiply it by 4 for quarts, and cut off four figures, when the figure, if any, on the left hand, will be quarts; and if there is still a remainder, multiply it by 2 for pints, cutting off as before.

Thus if 10 be multiplied by 100, and the product 1000 be divided by 31.5, it will give the quotient 35 nearly, against which in the table is .3119. Multiply the content, 100.78 by it, which will give 31 gallons and 4332 for a remainder, which is something more than 3 pints; and so much is supposed to be drawn out of the vessel.

Note, This rule is exactly true for a cylindrical vessel, but for casks, where the difference between the head and bung diameters is considerable, there will be an error; for the vessel will contain more liquor than this rule makes it, if it is more than half full, but less, if it is more than half drawn out. But if the difference betwixt the bung and head is not very much, the error will not be so great; and it may serve as a method proper to be adopted in common practice, though not strictly true.

Some useful Information to the PUBLIC in general, and to MILITARY and ENGINEER OFFICERS in particular.

WE proposed to have given some instructions relating to the Excise and Customs, which are the most considerable branches of the revenue; but they are under such regulations, that any intelligence we can communicate must be very short of the instructions which the respective officers are acquainted with by stated orders of government. On these heads, therefore, it is unnecessary to enlarge; we shall only shew in this place the usual method of finding the tonnage

tonnage of ships, which may be the more acceptable, as by a late act of parliament all ships and vessels are to be measured and registered, on pain of seizure and condemnation.

To find the Tonnage of a Ship, or the Number of Tons which by Admeasurement any Ship is supposed capable of carrying.

Rule. Measure the length of the keel, and of the midship beam within side, and also the depth of the hold, in feet; and having multiplied them into each other, divide the last product by 94, and the quotient will be the number of tons.

N. B. Vessels which are moulded for the convenience of stowage, will usually carry from one-third to one-fourth more than is given by this rule.

Example. If the length of a ship's keel be 46 feet, her breadth (or length of the midship beam) 23 feet, and her depth 11 feet; required the number of tons that ship will measure?

$$\begin{array}{r}
 46 \\
 23 \\
 \hline
 138 \\
 92 \\
 \hline
 1058 \\
 11 \\
 \hline
 94 \overline{) 11638} (123 \text{ Tons and about } 3 \text{ Qrs.} \\
 \underline{94} \\
 223 \\
 \underline{188} \\
 358 \\
 \underline{282} \\
 76
 \end{array}$$

Hence, as noted above, by adding one-fourth, the true burden may be estimated at 150 tons or upwards.

K k

With

With respect to military matters, the technical language should be explained in the first place, to render the subsequent information intelligible to our readers. We shall therefore briefly state the meaning of such words or terms as usually occur in conversation upon this subject.

The *Establishment* of a regiment, is meant of the daily pay of the several officers and soldiers in such regiment.

Subsistence-Money is that which is paid at present to every officer and soldier in a regiment, to supply their present necessities.

Regulation of Subsistence has respect to some extraordinary occasion, and being more or less as necessity requires, is renewed whenever it is proper.

Off-Reckonings is such a proportion per day as is deducted for each man's pay for cloaths.

Poundage is the Paymaster-General's allowance of one shilling in the pound for all money he pays for the army's use.

Royal-Hospital is a deduction of a day's pay in a year, from both officers and soldiers.

An *Agent* of a regiment is appointed by government to transact the business of the regiment, who is to account with the Paymaster-General for all money issued from the Pay-Office. He is allowed two-pence in the pound of all money he receives from the Paymaster-General, and has also one man's pay in each company.

Contingencies, are accidental charges of a regiment on a march, or in garrison.

Here

UNIVERSAL COMPANION. 375

Here follows a statement of the daily expence of an established regiment of horse, the numbers being as under.

Staff and Field Officers.

	£.	s.	d.
Colonel, as Colonel, <i>per diem</i> —	0	19	6
Lieut. Colonel, as such —	0	8	0
Major, as such —	0	5	6
Chaplain —	0	6	8
Adjutant —	0	5	0
Surgeon —	0	6	0
Kettle-Drum —	0	3	0
Sum	2	13	8

For one Troop.

Captain, for himself and two horses, } at 2s. each —	1	1	6
Lieutenant, and two horses —	0	15	0
Cornet, and ditto —	0	14	0
Quarter Master, and one horse —	0	8	6
Two Trumpeters, each 2s. 8d. —	0	5	4
Three Corporals, 3s. each —	0	9	0
59 Private men, 2s. 6d. each —	7	7	6
	11	0	10

Now supposing the regiment to consist of five troops more, at the same rates and numbers, the pay of the six troops will come to 66l. 5s. and the total charge of this regiment for a day will be 68l. 18s. 8d.

N. B. Should it be objected that this estimate is imperfect or erroneous, it will not be disputed; all that is intended by it, is to shew the method of calculating those accounts, in which there is better ground of success.

The Regulation of Subsistence.

	£.	s.	d.
Colonel and Captain	1	11	0
Lieut. Colonel and Captain	1	2	6
Major and Captain	1	1	6
3 Captains, 16s. each	2	8	0
6 Lieutenants, 11s. 6d. each	3	9	0
6 Cornets, 11s. each	3	6	0
6 Quarter-Masters, 6s. 6d. each	1	19	0
Chaplain	0	5	0
Adjutant	0	4	6
Surgeon	0	4	6
Corporals 18, at 2s. 6d.	2	5	0
Kettle Drummer	0	2	6
Trumpeters 12, at 2s. each	1	4	0
354 Men, at 2s. each	35	8	0
	54	10	6

How to compute the Off-Reckonings.

Supposing that an estimate is to be made of the off-reckonings from April 1st, 1786, to Sept. 30th, 1787, both days included; the full pay for this time, being 548 days, will amount to 37775*l.* 9*s.* 4*d.* Then the off-reckonings of 18 corporals and 354 men, making 372 men, at 6*d.* each per day, for 548 days, being 9*l.* 6*s.* per day, comes to 5096*l.* 8*s.*

Deductions from the Off-Reckonings.

	£.	s.	d.
Poundage of the full pay, is	1888	15	5 $\frac{1}{2}$
Royal Hospital	72	16	6
Agency	329	11	9 $\frac{3}{4}$
Total	2291	3	9 $\frac{1}{4}$

Now if this 2291*l.* 3*s.* 9*d.* $\frac{1}{4}$ be subtracted from 5096*l.* 18*s.* leaves 2805*l.* 14*s.* 2*d.* $\frac{3}{4}$ for the nett off-reckonings.

The

The Servants Off-Reckonings.

The Colonel	6	Servants
5 Captains	15	
6 Lieutenants	12	
6 Cornets	12	
6 Quarter-Masters	6	

Sum 51

Then 51 servants, at 6*d.* *per diem* each, for 548 days, amounts to 698*l.* 14*s.* From this sum must be deducted, as follows.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
<i>Poundage</i> of their full pay, being } 3493 <i>l.</i> 10 <i>s.</i>	174	13	6
<i>Royal Hospital</i>	9	11	3
<i>Agency</i>	29	2	3
Total	213	7	0

Now if this 213*l.* 7*s.* be taken from 698*l.* 14*s.* it leaves the sum of 485*l.* 7*s.*; which remains being subtracted from the *nett off-reckonings* before found, 2805*l.* 14*s.* 2½*d.* the remainder will be 2320*l.* 7*s.* 2½*d.*

N. B. The *Poundage* and *Royal Hospital* allowances are stopt by the Paymaster-General; and the *Agency* by the Agent.

We shall next present a sketch of a Colonel's, Captain's, and Cornet's account, with an account for one of the troops, supposing the numbers to stand as under.

Dr.			Colonel in Account.			Cr.		
			£.	s.	d.			
To Poundage of his full pay	-	-	56	3	4 $\frac{1}{2}$	By 548 days pay, as Colonel and Captain, from April 1st, 1786, to Sept. 30th, 1787, at 2l. 1s. per diem	1123	8 0
Royal Hospital	-	-	3	1	6 $\frac{1}{2}$	Neat Off-Reckonings of 6 Servants for that time	57	2 2 $\frac{1}{2}$
Agency	-	-	9	6	2 $\frac{1}{2}$			
Subsistence, at 31s. per diem			849	8	0			
Arrears paid			107	5	3			
Off-Reckonings, his Servants			55	6	7			
Balance due	-	-	99	19	2 $\frac{1}{2}$			
			1180	10	2 $\frac{1}{2}$			

Dr.			Captain in Account.			Cr.		
			£.	s.	d.			
To Poundage	-	-	29	9	1 $\frac{1}{2}$	By 548 days pay, as Captain, and three Servants, from April 1st, 1786, to Sept. 30th, 1787, both days included, at 1l. 9s. per day	794	12 0
Royal Hospital	-	-	1	12	3 $\frac{1}{2}$			
Agency	-	-	4	18	2 $\frac{1}{2}$			
Subsistence at 18s. per diem, for 165 days, by regulation			148	10	0			
Ditto at 17s. per diem, for 383 days, by regulation			325	11	0			
Off-Reckonings, his Servants	-	-	28	11	1			
Balance	-	-	256	0	4 $\frac{1}{2}$			
			794	12	0			

Dr.			Cornet in Account.			Cr.		
			£.	s.	d.			
To Poundage	-	-	19	3	7 $\frac{1}{2}$	By 548 days pay, as Cornet, and two Servants, from April 1st, 1786, to Sept. 30th, 1787, at 14s. per day	383	12 0
Royal Hospital	-	-	1	1	0 $\frac{1}{2}$			
Agency	-	-	3	3	11 $\frac{1}{2}$			
Subsistence for 165 days, at 11s. per day			90	15	0			
Ditto for 383 days more	-	-	212	5	6			
Off-Reckonings, account of			19	1	4			
Balance	-	-	38	1	7 $\frac{1}{2}$			
			383	12	0			

Dr.

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Dr.	£.	s.	d.	Cr.	£.	s.	d.
To <i>Subsistence</i> , in account -	2478	12	3	By the <i>Subsistence</i> of			
<i>Debts</i> in quarters	397	5	6	1 Kettle Drum at			
<i>Provisions</i> in transportation -	75	18	8	2s. 6d. 2 Trumpeters, each 2s.			
<i>Balance</i> due to the Troop -	664	19	7	3 Corporals, 2s. 6d. each, and 59 private men, at 2s.			
	3616	16	0	each, from April 1st, 1786, to Sept. 30th, 1787, or 548 days, at 6l. 12s.			
				per day -	3616	16	0

It only remains to shew the method of finding the Poundage, Royal Hospital, and Agency of the regiment, in which a short information will suffice.

1. *For the Men.* Having found the amount of their daily pay, the Royal Hospital allowance will be obtained by this proportion; as 365 days is to such daily pay, so is the given number of days (whether more or less than a year) to the sum required. And for the Poundage and Agency, say, as 1 day is to the daily pay, so is the given number of days to the full pay for such given time; with which, by the rules of Practice, find the Poundage at 1s. in the pound, and the Agency at 2d. in the pound.

2. *For the Officers.* On account of the difference in their pay, a proportion must be made for each officer, in order to find their respective quotas for the several purposes above mentioned, as follows. For the Royal Hospital allowance, say, as 365 days is to the respective officers pay per day, so is the given number of days to his quota of allowance. And for the Poundage and Agency, use the same proportions for the whole pay of each officer respectively, and by Practice, as before, find the Poundage and Agency.

To find the Number of Shot contained in a complete Pile, having the Number of the Base given in Length and Breadth.

This proposition is of great utility to engineers and others, in taking an account of ordnance stores in any
of

of his Majesty's dock yards, garrisons, &c. &c. And though I have seen tables ready calculated for this purpose, I have never met with a rule, by which, in defect of such tables, the number could be ascertained at once. However, from considering their pyramidal form, and the nature of square numbers, I am happy in supplying that deficiency by deducing the following plain, practical rules, for finding the number of shot, without the help of any intermediate numbers; whilst those who may be in possession of the rule, if any such was ever published, which I much doubt, after perusing an almost incredible number of authors in the different branches of the mathematics, &c. the merit of the discovery, if it has any, must be sufficient to stamp upon it the character of original.

Rule 1. If the pile is square, containing the same number in length as in breadth, add 1, or unity, to the number of such side*, and multiply the sum by such number, taking half the product, which call A. Then multiply A by twice the number contained in a side, and divide the product by 3; and if to the quotient you add one-third of A, the whole number of the pile will be obtained.

Rule 2. If the pile contains more in length than in breadth, take the difference, and proceed with the breadth as for a square pile; and having multiplied A by this difference, add the product to the former result for the square pile, and the sum will be the required answer.

N. B. The difference betwixt the length and breadth of an oblong pile of shot may be had at sight, by subtracting 1, or unity, from the number of shot on the ridge of the pile.

* This addition may be considered as the sum of the two extremes in Arithmetical Progression, and the first part of the operation, as finding the sum of the terms, see p. 208; the other part of the operation is deduced from the method of finding the content of square pyramids, see p. 359; or the Young Measurer's Complete Guide, by Mr. Fenning, last edition, p. 138.

Example

UNIVERSAL COMPANION. 381

Example 1. What number of shot is included in a square pile, each side of the base containing 28?

OPERATION.

$ \begin{array}{r} 28 \\ 1 \text{ Add} \\ \hline 29 \\ 28 \\ \hline 232 \\ 58 \\ \hline 2)812 \\ \hline 406 \text{ or A} \end{array} $	$ \begin{array}{r} 406 \\ 56 \text{ or twice } 28 \\ \hline 2436 \\ 2030 \\ \hline 3)22736 \\ \hline 7578\frac{2}{3} \\ 135\frac{1}{3} \text{ or } \frac{1}{3} \text{ of A} \\ \hline 7714 \text{ Answer.} \end{array} $
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Example 2. What number of shot does an oblong pile comprise, its length having 33, and its breadth 23?

$ \begin{array}{r} 23 \\ 1 \text{ Add} \\ \hline 24 \\ 23 \\ \hline 72 \\ 48 \\ \hline 2)552 \\ \hline 276 \text{ or A} \end{array} $	$ \begin{array}{r} 276 \\ 46 \text{ or twice } 23 \\ \hline 1656 \\ 1104 \\ \hline 3)12696 \\ \hline 4232 \\ 92 \text{ or } \frac{1}{3} \text{ of A} \\ \hline 4324 \end{array} $
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$ \begin{array}{r} \text{Then } 33 \\ 23 \text{ Sub.} \\ \hline 10 \end{array} $	$ \begin{array}{r} 276 \text{ or A} \\ 10 \\ \hline 2760 \\ 4324 \text{ Add} \\ \hline 7084 \text{ Answer.} \end{array} $
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N. B. This pile will appear as a ridge, having 11 shot in length; hence one less, which is 10, will be the difference of the sides.

Valuable

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---	--

N. B. This pile will appear as a ridge, having 11 shot in length; hence one less, which is 10, will be the difference of the sides.

Valuable

VALUABLE *Receipts in* PHYSIC, *most of them simple, and approved from the Author's own Experience; the rest communicated as such by Friends of Reputation.*

To cure all Sorts of Swellings, Green Wounds, and Broken Breasts.

TAKE of sage, spike, camomile, wormwood, and southernwood (all fresh and green) each four ounces, with eight ounces of wild red roses, which cut fine, and put to a quart of sweet oil; stir them every day for three weeks, and then simmer them two hours over a gentle fire in a bell-metal pan, keeping it from burning by stirring all the time. This will take away the watry parts, and leave about a quart of oil of a beautiful green. It must be made in June, when the roses only can be had.

An Ointment for old Aches.

Take a sufficient quantity of camomile, wormwood, fox-flowers, and red-weed, each alike, which bruise and boil with fresh lard, and then strain it off. Use it warm. It is good for pains in the back, bruises, and green wounds also.

A Plaster for the same.

Take a little of the last mentioned ointment, which boil with a quarter of a pint of fallad oil, and a quarter of a pound of red lead, till it cements into a plaster, which make into small rolls.

To cure or relieve a White Swelling.

If the part affected be anointed with a mixture of althæa ointment, spirits of wine camphorated, and spirits of turpentine, the swelling may be reduced. Many patients have been entirely cured by it.

For

For parched Lips.

Mix a small piece of allum in white-wine vinegar, a little water, and some honey, and anoint the lips with it. Or you may use raw cream only.

To cure swelled Lips.

Take of Lucatella's balsam, flour of brimstone, clarified honey, and cold drawn linseed oil, of each a like quantity, which pound together in a stone mortar, and anoint the lips.

To cure a bad Bruise.

Make chalk with brandy into a plaister, which will take off the blackness, and drink spruce beer in which Irish slate has been put.

For the Itch.

Mix some fine Bay salt with an equal quantity of flour of brimstone and a little sweet oil to make it of a due consistence. Rub it well into the palms of the hands, and in three or four days it will effect a cure.

To relieve Deafness.

Take the pith of a cabbage stump, and put a little piece in each ear; keep the ears warm with cotton or wool, and in three months the hearing will be restored.

For a Sprain or Swelling.

Mix some bole armoniac with the white of an egg, and apply it as a plaister. It immediately abates the swelling, and eases the pain.

For a livid Swelling in the Leg or Arm.

Boil a quantity of chick-weed in the lees of good beer or ale, and apply it warm as a poultice, very thick, to the part, and it speedily removes it, although it be so bad as to dent or pit after touching with the finger. It must be repeated several times, and the part must be kept warm afterwards for some time.

An

An excellent Ointment for Ulcers, Tetters, &c.

Take six pounds of fresh butter, and purify it from dregs and moisture by boiling and skimming; then with four pounds of yellow wax, two pounds of rosin, and one pound of Venice turpentine, make it into an ointment, somewhat solid, to lay on as required. It is good for chilblains, chaps and clifts of the breasts, and other parts of the body.

For chopped Nipples in Women who give Suck.

Toast some cheese, and preserve the oil which drops from it, wherewith anoint now and then by means of a feather. It is the best and safest remedy known.

To prevent a Suppuration of Women's Breasts.

Take fresh milk, camomile flowers, Venice soap, and some salt, which make into a poultice, to be applied warm to the breast. If this is used in time, scarce any complaint of this sort would come to a sore. Or, having squeezed the water out of boiled turnips, mingle it with some new butter unsalted; apply this warm to the breasts, on a thick cloth, very large, changing it morning and evening, and in three days it will remove the hardness and pain.

To cure the Head-ach, Sore Eyes, &c.

Boil a good handful of ground-ivy, both leaves and stalks, being first washed and swinged dry in a cloth, in a quart of good beer to a pint, of which take one half in the morning fasting warm, and the other at night going to bed, sweetened with soft sugar. It not only cures inflammations and humours of the eyes, but the jaundice, and those coughs which generally are the forerunners of consumptions.

For a violent Cold, with Cough and Hoarseness.

Bruise a good quantity of ground-ivy, which mix with an equal weight of brown sugar-candy, and boil it to a thick syrup; take one or two spoonfuls, night and morning, for a dose, till the cold is removed. For
a cold

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a cold and cough without the hoarseness, the tea drank often, sweetned with brown sugar, will commonly do. Many lives have been preserved by means of the syrup.

For Blindness after the Small Pox.

Take half an ounce of the inner or green rind of young elder, which put in half a pint of white wine about six in the evening, and after steeping twelve hours, strain it dry through a cloth, for a draught. It will make the child sleep, and whilst he is asleep (for he must awake of himself) boil five sprigs of rosemary, with as many of winter savoury and parsley, and a quarter of a pound of currants, in a pint of water-gruel, and when he wakes give him as much as he can drink. This is a famous receipt, and the author of it advises to use red port for a girl, and to scrape the rind of the elder upwards in spring and summer, and downwards in autumn and winter. Those who have a mind to use it may omit or attend to these particulars at pleasure.

A noted Receipt for the Eyes.

Pound some white sugar-candy, and mix it with juice of houseleek, and apply it to the eyes.

For a Person much decayed in a Consumption.

Take two quarts of the richest new red cow's milk, which put in an oven while the household bread is in, with brown sugar-candy and syrup of roses, each two ounces, in an earthen vessel of three quarts close stopped, of which take some warm two or three times a day. If two ounces of ground-ivy syrup be added, it will be the better.

For weak and decayed Lungs.

Bake a quantity of turnips in an oven, while the household bread is in, then press out the liquor and strain it through a flannel bag; and to a quart of liquor put half a pint of brandy, or aniseed water, and two
L 1 pounds

pounds and a half of double refined sugar. Make a syrup only by dissolving.

For the Stomach.

Take four ounces of the thin yellow rind of oranges candied and cut small, with aniseeds, caraways, and fennel, of each two ounces, aromaticum rosatum half an ounce, salt of wormwood a dram, powder of dried spearmint two scruples, and of sugar-candy the weight of them all, or near eleven ounces. Make these into a powder, but not too fine, and take a dram of it after every meal; and by its warming cordial properties it strengthens the stomach and promotes digestion, expels wind, prevents crudities, and causes a sweet breath.

For the King's Evil, and other Scrophulous Complaints.

Take of sage and rue each a good handful, being well picked from the stalks, which bruise a little, preserving the juice. Put them in a thin bag, and hang them in four gallons of table beer new, and after it has worked or fermented, use it for common drink at meals, and at any other time. Before one vessel is drank, always prepare another, and, though disagreeable at first, constant use will soon make it palatable, and by continuing it some months, the humour will abate, and a cure be effected by perseverance. A quarter part of white wine may be mixed with it in using, to make it more agreeable; but it is more efficacious by itself. Use good, wholesome diet, which is easy of digestion, avoiding salted provisions and too much fish or butter; but you need not be afraid of the gravy of roast beef or mutton, taking care that your meat is not too much done. This has done surprising cures in various complaints, and is well worth attention.

For the Dropsy.

Pound as many artichoke leaves in a stone mortar as will make a pint of juice, which mix with a pint of Madeira wine, and take two or three spoonfuls every

every morning fasting. If it falls into the legs, a roll or piece of bread, about two parts baked, laid on as warm as you can bear it, will draw off the water; and if it is so sharp as to pierce the skin, apply the chickweed, as directed before for a livid swelling. If the bread is baked more, it will not so soon affect the skin. It is advisable also to eat hot bread every morning, and to drink only half a pint of good mild ale or beer in twelve hours.

Dr. Bate's Cordial Elixir for the Scurvy, Gout, Gravel, &c.

Take of the roots of elecampane, florentine orris, and liquorice, with the seeds of anis and caraway, of each two ounces, with two handfuls of the leaves of Carduus Benedictus, a pound of raisins of the sun sliced, of sena cleansed 9 ounces, jalap in powder an ounce and a half, pot alhes an ounce, and of aniseed water three quarts. Mix and digest them for four or five days, and then strain and press out the liquor; of which take two spoonfuls at bed-time for a dose, and three or four early the next morning. It is usually sold for half a crown, and far exceeds Daffy's elixir for every internal malady which that medicine is famed for: scarce any complaint of the stomach or bowels can resist it; the jaundice, dropsy, and even the stone yielding to its power.

For Burns or Scalds.

The scraping of cold raw potatoes laid thick upon the part is an excellent medicine to take out the fire. But for those acquainted with Goulard's tincture of lead, properly diluted, this is an excellent remedy, in judicious hands, for this and many other complaints of an external nature.

To prevent infectious Disorders.

Persons who are obliged to attend patients in epidemical and contagious disorders, should take care never to swallow their spittle while in the room, or within the reach of the effluvia they emit. It is bet-

ter to be guilty of a degree of rudeness or indelicacy, by spitting out the saliva, than to submit to the contrary and almost certain alternative of catching the fever or other complaint. Nurses, and others attending, should frequently leave a sick room for fresh air; and clergymen, who, by their office, are often surprised to visit persons in such dangerous situations, would do well to attend to it. The spittle, which will flow more plentifully at such times, may be emitted into a handkerchief, which should be put out of the pocket as soon as possible, and washed out clean. Physicians, surgeons, and apothecaries, have sometimes fatally experienced the neglect of this simple precaution. A small quantity of rue and wormwood stuffed up the nostrils is an excellent preservative.

N. B. One or other of these methods I constantly make use of on all occasions; and have thus avoided many epidemical disorders, which my constitution and profession otherwise would certainly have exposed me to.

Of the Causes and Cure of

CONSUMPTIONS *of the* LUNGS.

TO those who have ever seen the bills of mortality, unless devoid of all humanity, it must have occurred, that those who die of Consumptions may be estimated from one fifth to one fourth of the whole number. This is certainly a melancholy reflection, and every person of sensibility and feeling must lament the effects, however ignorant of the causes.

It must indeed be acknowledged, that in villages and smaller towns in the country, this proportion is generally much less: but supposing that only one in ten should usually die of these causes, and that one half of these die of consumptions from other causes, the proportion of one in twenty in the country, and of one in
ten

ten in cities and great towns, is a very great public loss, and every probable mode of obviating the calamity is entitled to public consideration. Hence it is surely of importance to point out the means of diminishing the number, and of rescuing some of those many useful * lives from the sacrifices of such a prevailing disease.

As this work will doubtless fall into the hands of many, who from indigence cannot obtain medical assistance, or from distance of residence are almost precluded from it, the observations here offered may be of the greatest service to those, whose constitutions may dispose them to this complaint. These may be the more generally useful, as the Apothecary and Doctor are much less necessary in these cases than may frequently be imagined; that they may be useful, however, is not denied, but it is less from physic than from advice that such utility is to be considered. They may distinguish more accurately, from the different symptoms, the different stages and progress of the complaint, and consequently determine with greater probability of success the methods of cure to be pursued.

The approach of consumptions may generally be perceived in sufficient time to check the farther operations of their causes, where such causes are indicated to proceed from the lungs. This confident assertion may perhaps be thought to border upon quackery; but we wish to speak generally, not absolutely, for in some cases the advances may be so rapid as to baffle all endeavours to counteract it. But we confine ourselves solely to consumptions arising from affections of

* It is to be lamented, that this disease mostly affects the active part of mankind, and in the most active period of human life. As the good of society is more essentially injured on this account, and its coming on frequently when persons are but just commencing a busy life, every person of common philanthropy, every political arithmetician, every patriotic minister, every good monarch, is concerned to avert the evil effects of a complaint, which, like a secret enemy, saps and undermines the very fundamentals of the constitution unperceived, weakens the internal strength of the kingdom, and impoverishes the state by the loss of so many subjects.

the lungs, where the special and particular causes are such as we have hereafter assigned, for we mean not to treat of those arising from other causes; nor should we wish even to intimate those called dorsal consumptions, but to guard our readers against some mistakes they might otherwise fall into, as confounding the diseases, which in themselves are different, and have different causes. It were to be wished, that consumptions of this latter class were less frequent, and that the youth of both sexes could be impressed with a more horrible idea of their effects. Medical works, expressly wrote for this purpose, may be obtained from any bookseller of eminence, which shall preclude our further mention of them in this place, as the destructive effects must, at first reading, point out the cause to those who are habituated to such destructive vices.

We shall first instance in those symptoms which seem to have been caused by some wound or bruise. It cannot be denied, that these may in their consequences affect the lungs, and that such complaints are not easily relieved or fully cured; but it is as certain, that letting blood, in proper quantities, and the operation repeated as long as seems necessary, will frequently succeed in restoring the patient. But care must be taken to use such diet as seems most proper to prevent any fever, and consequently inflammation; when nature, without any other remedies, will commonly effect a cure. It might be needless to caution such patients, from the very first approaches of the disease, to forbear absolutely the use of fat bacon, salted meats, pork, cheese, or other food, which is in the least degree difficult of digestion, and to refrain from all violent exercise or labour; but as we are writing for the benefit of those who live much on such diet, we could not omit so salutary a prohibition, as relief in a great measure depends upon it. When such bruise or wound, either from neglect or violence of its effects, shall become ulcerated within, in spite of the above precautions, the proper method of treatment must vary greatly, as will presently appear; for we must then consider the ulcer only, independent of the cause.

Pleuritic

Pleuritic complaints very frequently occasion consumptions of the lungs. Sudden and violent pains or stitches in the side are most frequent in cold and wet seasons, especially in spring; in damp, low, marshy situations they prevail much. Fomentations have been used in these cases with good effect, nor should plentiful and repeated bleedings be forgot; these indeed are absolutely necessary, which alone will commonly prevent an abscess, as it mostly ends in that without these precautions. Blisters near the part affected are particularly to be recommended; and we need scarcely add the necessity of a cool, diluting diet, with the strictest guard against violent exercise or excess of passion. And as the patient is in danger of being suffocated or choaked when it bursts, it should be guarded against the more carefully; but if the matter is coughed up, an ulcer may be the consequence, and every symptom of a confirmed consumption immediately follow. In this case, as before, we must endeavour only to cure the ulcer.

Again we may consider the bursting a blood vessel as a common cause of consumptions of this nature. This is often occasioned by sudden changes of weather, particularly by excess of heat following extreme cold. Persons of a fair complexion and delicate skin, if they are of slender make, have a long neck and narrow chest, are most subject to it; some families are naturally liable to it, which is generally indicated by these circumstances more or less. Nor is it unusual to observe in conversation, that such a person has a consumptive look; so strongly are the symptoms marked in the countenance, sometimes for years before the constitutional bent becomes serious and alarming. Persons of this shape may do much by way of prevention. In spring, when the blood usually rarefies and expands sooner than the solids relax, bleeding is particularly necessary, to hinder the blood vessels from becoming too full, and thus may be taken away the cause of their bursting. Violent exercise is also to be avoided at this season of the year, and more especially upon mountains, and in a purer air; nor can we too strictly caution such persons against playing on wind instruments.

Flannel

Flannel worn next the skin, and other precautions against taking cold, should be carefully attended to; and a low diet is indispensable in spring. Ripe fruit and vegetables are of the first importance; not only to prevent the disease, but to correct and cure it when the lungs are affected.

Another cause which may produce ulcers in the lungs, arises also from obstructed perspiration, which is frequently occasioned by moist, foggy weather; not only pleurisies, rheumatisms, and other complaints proceed from it, but obstructions of the glands, scrophulous complaints, tubercles or swellings of the lungs, &c. for the internal glands are very often affected when no swellings appear outwards. With care and attention, inflammation may be prevented from these tubercles; or an inflammation may be hindered from forming matter; but when matter is formed, it must go on till it bursts. If this be coughed up, and particular care is had to diet, which should be light, but frequent, and in small quantities; and if at the same time gentle exercise in an open air, particularly in the morning, be taken, much good may be expected from it. But should the matter be discharged inwardly between the breast or side and the lungs, no time should be lost in procuring a skilful surgeon to open it; this being the only chance for saving the patient's life, and commonly succeeds, if it has not been neglected too long, the operation being much less alarming than is usually imagined.

We have observed, that frequent and repeated blood-letting is absolutely necessary in spring to some constitutions for preventing this fatal disease; it is so likewise to check the inflammation of the lungs. But when matter has begun to form, it must not be used on any account, except to stop a violent pressing stitch of the side, or pleuritic pain, and then only in a small quantity. We should here advise the application of blisters, or setting an issue, which may be of the greatest service.

As light food is absolutely necessary in this disease, we may be excused in pressing it again and again. If milk, made into a broth with oatmeal, agrees with the stomach,

stomach, nothing is so good: sometimes it will succeed better, if weakened with some water before boiling, as milk alone may not only be too heavy for the stomach, but endanger too great a swelling of the blood vessels, which must be prevented, if possible, for reasons already given. Chicken or other light broths, plain currant or raisin puddings, and other light diet, may also be used. If juice of lemons agrees with the stomach and bowels, it may be taken plentifully, and will correct those wasting sweats, to which consumptive persons are much disposed. Elixir of vitriol, frequently taken in small quantities and proper doses in the patient's common drink, is of the utmost service.

When the cough, which generally seizes persons in this complaint, is very troublesome, and prevents sleep, small opiates may be useful; but as such medicines are not to be trifled with, they should not be taken without the advice of the faculty, or some persons well acquainted with their properties and effects. It has also been advised to take the Jesuit's bark in small quantities and in repeated doses; this may be extremely serviceable, after the abscess is formed, to check the tendency of the humours in that stage of the disease to putrefaction; nor does the whole system of pharmacy or chymistry afford an equal medicine for this purpose. But we would wish to recommend to the persons for whose use this article has been given, to act under the directions of some intelligent apothecary whenever they have recourse to medicine; for here we may be supposed to exclude the physician, who seldom is called in to those persons for whose information we are now writing.

These observations being of such a nature as to carry conviction, and to exhibit before the eye of the most common understanding the cause, progress, and effects of this complaint, we have the more studiously endeavoured to convey them in a language plain and intelligible; those for whom they are more especially calculated will be thankful; and in this, as in the case of suspended animation, which we have descanted upon in this work, we hope for the confidence and encouragement of the faculty in a case which calls forth all
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the powers of humanity. It may truly be observed, that it so perfectly corresponds with the title of our work, that no article in the whole book is more worthy a place than the subject we have here treated.

On FLY-FISHING *and* ANGLING.

Just in the dubious point, where with the pool
Is mix'd the trembling stream, or where it boils
Around the stone, or from the hollow'd bank
Reverted plays in undulating flow,
There throw, nice-judging, the delusive fly.

THOMSON.

SO sings the immortal bard, and he speaks the language of an experienced artist in the executive part of Fly-Fishing. The whole description (see l. 391—439 of his *Spring*) is beautiful, which the oldest practitioners need not be ashamed to learn from. One of the most necessary articles for this purpose, is a knowledge of making your own rods; and perhaps none are found equal to those made in Yorkshire and the more northern counties, where every school-boy is taught how to do it. It is a fault to make them too long, fourteen feet being commonly long enough to be managed with one hand. An adept in this art will cast an artificial fly at the end of a line of twenty-four or twenty-five feet within six inches; and with a rod of twelve feet will lay any wager of casting the fly into the top of a quart pot. A fine taper hazel, about eight or nine feet, gathered about November, and properly seasoned, makes the best root, though a piece of fir, from the sap side of a deal board, will make a good one. The best tops are made of elder, about three years old; the thick end of the branches is best, and as the knots at each succeeding joint come out at different sides, two pieces may be had from the length of the two lowest joints, without any knot, of near
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two feet in length. The upper joints may be split into four pieces, and the bark and pith being shaved off, and every joint tied by itself, after twelve months it will be fit to be made up for use. Having planed or carefully worked the pieces nearly square, dress off the corners with a file till they become exactly round, taper, and smooth. Then splice off the joints even, so as to fit close, rub them very thin with shoemaker's wax, and wrap very close with fine white silk well waxed; the outside of the joint should be filed off so that the joint may not appear much thicker than the nearest part of the piece above it. You may make the top for small or artificial flies about six feet long, having a very small piece of whale-bone, nicely wrought, of about six inches, a loop of twisted hair being nicely tied upon the end to fasten the line to; but for large flies, minnows, &c. a top of five feet will be long enough, ordered in like manner. One root will commonly do for both; and, if the tops are well made, these may indifferently serve for either purpose, without the trouble of a man or a horse to carry a load of cumbersome and useless lumber. Such a sight would be as novel to the women and children of a north country village, and the curiosity of the labouring peasants would be as much excited by such an extraordinary character, as to see a bear pawing a plumb-cake, and dancing a minuet, and at every turn of the figure feasting himself with the spoils he had reaped.

Our limits will not admit of being particular in giving directions for making lines. We can only say, that they should taper gradually from the top, be smoothly twisted, and (if you knot them) well secured. Make a loop at the end of your plaited or twisted line, through which the flies of your fly link must be drawn, the very small loop at its upper end being first drawn over the other at the end of the line. The end fly should be dressed, but the second fly above it should only be a hackle; the first representing a fly in a sitting position, the latter upon wing. Seven or eight feet of your line next the end should be of fine strong horse hairs, of a bright silver colour, tied singly to the end of each other, and to these the flies should be fastened;

tened; but if these cannot be procured, fine silk-worm gut must be used for the purpose.

I would recommend a stick of hazel or fir, not much thicker than the bottom of your rod; to the small end of which, a ferule being put, a hoop, with an arming of iron and a screw, should be screwed in. This is of excellent use, if the loops of a small net, somewhat deep, are put on it, for landing your fish: you should also have a hooked knife, such as gardeners use, with a plain turned hook, with male screws, to put on occasionally, for cutting off or breaking a branch or weed, when your line is by any means entangled. These are mentioned, because not generally known or used; besides which, a north country fisherman always carries, slung over his right shoulder and under his left arm, a panier of willow work or thin board, with a small hole in the top for putting in his fish, as it is necessary in those rivers, during most of the summer months, to go into the water, to fish the streams in such a direction as Mr. Thomson points out, sometimes to the distance of twelve or fifteen yards from either shore.

As we cannot find room to mention particularly the several kinds of flies, or give directions for making artificial imitations of them; of the latter we can only say, that all rules will fall short of the instruction to be had from seeing any person make two or three; and for the former, that a woodcock's wing, a pheasant's, some fine coloured chicken feathers, a starling's wing, with those of the partridge, the brown owl, and a black and yellow cock's hackle, will furnish you with variety of colours to imitate the wings. Experience will direct you to other sorts. For the bodies, silk of different colours must be chose, and down or fur of different animals is advisable for the same purpose, which should always be-wet to try if it is an exact colour; because when wet they will always appear darker than when dry. The ant-fly, which is a famous killing fly in northern rivers, can only be imitated by a bright brown horse hair, or something similar; and the body of the stone fly, only by the blackest part of the fur of an old English rat.

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They have a method of fishing in some parts of Hampshire, about May and June, with a double line, which is a very destructive way to the best trouts. They have two long rods of hazle, pretty strong and heavy, of twenty feet long, or more, to the top of which they fasten a silk line of thirty or forty yards long, according to the breadth of the river; on this line they slip a loop of hair of six or seven feet in length, sufficiently near one end to drop the hook, when baited, upon the surface of the river, and to keep it swimming with the current. Two persons are necessary, one on each side the river; who, having stuck their rods upright in the ground by means of sharp points, and collected a number of flies into small boxes from the bulrushes, &c. near the river, upon seeing a trout rise, immediately take the rods up, bait the hook with two flies, at the end of a fine and strong Indian weed, and the man on the opposite side standing nearer or farther off as directed, the other manages the line so that the flies shall swim over the trout. If the day is not too bright (which in that case prevents this exercise till near the evening), and the shade of the line is not perceived by the fish, he commonly takes the bait, and being gently struck, is suffered to run down the stream a little way, till, by keeping the top of the rods up, he can be brought about without too much violence; and one or the other playing upon him incessantly, as he moves to one or the other side of the river, he is soon drowned, and by means of a landing net fixed upon a stick of two or three feet long, put under him, he is secured, the other giving way as may be necessary. By this method several good trouts are very often taken in a short time; and it is no unusual thing to see a dozen or near a score of these double rods at this season within the space of a mile, where the currents are many or continued.

BOBBING or BUSH-FISHING, though done with one short stiff rod and a strong short line, has some circumstances similar to this. When the warm months commence, the best trouts commonly retire to the shady side of the water, watching the flies which drop from the bushes; two flies put upon a hook as before,

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and just dipping on the surface of the water, if you carefully keep yourself still and out of sight, will generally tempt a trout, when, as soon as he turns, you may gently strike him, and commonly secure him. Your landing net, either with a short or long handle, should be within reach of your left hand, while you are managing your fish with the right. After taking a fish, you should change your situation for an hour, as others will be frightened away.

ANGLING is a species of fishing, very different from the former. It is done by a ground bait, sometimes without a float, especially if you bait with a worm, but generally with a float of cork or a quill, to move higher or lower according to the depth of the water. For a perch, in the summer months, you may fish about six inches from the bottom commonly; but for a roach, from September to Christmas, when they are in season, about two inches from the bottom. For these, a grain of malt, the white end just appearing, is commonly a good bait; or a little dough worked up with some cotton wool to make it tough, and coloured with vermilion to a deep pink colour, is a very tempting bait. Little balls of white dough, or a few grains after brewing, thrown in frequently, so as to rest where you are angling, will draw them to the place, when you may expect good sport.

I shall only add, that the best places for laying night lines are the shallows either opposite to some good holes, as banks, roots, &c. or those nearest above or below, and never in the deeps, if you expect either the best trouts or eels.

Of SWIMMING.

AS an art of such importance to the community and to individuals cannot be too generally known, no other apology can be necessary for disseminating knowledge which may prove the means of saving many lives.

Though an expert swimmer will jump at once into the water, it is dangerous to the health to run in, as many do. On the contrary, a learner should go in gradually; but if, in leaping in, he should descend deeper than he chuses, by attempting to turn on his back that will be prevented. This is of use to stop his going to the bottom, though a learner in prudence will not go out of his depth.

The proper posture for swimming is, to have the head and neck upright, while the breast is advanced forward, and the back bent so as to lay down gently on the belly. Then draw the legs from the bottom, and immediately stretch them out again; also strike forwards with the arms, spreading them open, and then drawing them in towards the breast. By striking forwards, first with the feet, and then with the hands, without any fear of laying along on the water, it will soon become easy and pleasant. For though at first a learner may sink down in the water, and be almost stifled in holding the breath, by the use of bladders or reeds, corks, &c. that difficulty will be soon overcome, if the water is not deeper than the breast, or shallower than the belly.

When a person can swim well in this way, he should accustom himself to turn to the right or left. Stretch the palm of the right hand outwards, and the arm at the same time, drawing in the palm of the left hand as well as the arm. Thus may he turn to the left side, by inclining the head, neck, and length of the body to that side. By the contrary method he may turn about to the right.

To swim on the back, which a person may do a long time without tiring, lay down on the water, with the hands on the belly, striking out and drawing in the legs successively, within two feet of the water's surface. Much less water will be drunk in this way than by swimming on the belly, and the waves will be more easily passed through; there is also less danger of being entangled with weeds. Take care not to drop either foot to feel for the bottom, which is the ready way to sink; neither lifting the knees too high, nor sinking the hips and sides too low. By the assistance of some

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person, or a bundle of corks or bladders, this will soon be effected. Though it is not necessary to move the hands much in swimming on the back, which is chiefly used against the waves, yet to advance considerably both should be employed.

For avoiding boats, weeds, rocks, &c. incline the head and body to the side you would turn to, at the same time moving and turning the legs just as you would do upon land. To turn to the left, drive off the water with the palm of the right hand a little bent, but outwards from that side, at the same time with the left hand open and fingers close, driving the water on that side backwards. If you wish to turn to the right, do the same things with the contrary hands. Take care that the legs are not open, and that you have a sufficient depth of water not to hurt your back against the ground.

In swimming on the back, it is usual to go backward, pushing onward with the feet and legs. But to advance forward, let your breast be inflated, as your body is extended in a right line, with the hands upon the belly; and then lift up the legs one after another, drawing them back with all the force you can towards the hams, and so letting them fall into the water you will return to the place from whence you came. This greatly relieves a person when much fatigued, and is of great use at any distance from the shore.

It is easy to make a circle round the head as a centre, by sinking a little that side of the body to which you would turn, also lifting up that leg first, and then the other successively, and at each motion advancing the legs about twelve inches each towards that side. Take care not to lift the feet too high, which will sink down the head, nor strike the water too hard, if you would perform it agreeably. The parts of the circle described may be observed by the froth on the surface. By means of one leg and the arms, you may turn the head and the whole body round, as before, while the other foot remains immovable as a centre.

A person who is expert in swimming can almost do any thing. We shall shew some of the less common performances in this art. If both the hands are fast
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joined together, you may get forward by drawing them in first towards the breast, and successively striking them out, the legs at the same time being exercised as before. Thus a passage may be effected through weeds or reeds, &c. Or, if both hands are put behind the head, or on the back, by advancing forward the breast, keeping the neck upright on the water, and pushing forward with the legs and thighs, as by the common way of swimming on the belly, you may make way. This is very useful in the cramp, or any other case where the hands cannot be employed. If both legs are bound by weeds, &c. by turning on the back, using the hands, and striking the legs one against another, a person may gain the shore in that position.

If the cramp should seize a leg, it should be moved towards the hips, and held by the hand on the opposite side, at the same time swimming with the other leg and hand which are at liberty. By this means one may get rid of weeds generally; but if a person is wholly entangled, by imitating a dog he may commonly free himself. To do this, elevate and depress one hand successively after another, and also the feet, drawing the water towards you with the hands, and driving it from you with the feet. Begin with the right hand and right foot, and then use the left hand and foot, and so on.

To keep one foot at liberty in the several manœuvres of swimming, is matter of greater difficulty than it appears to be; for the chin must be drawn in towards the breast, which must also be inflated, the palms of the hands extended and turned towards the bottom, and the other leg employed in the water; or, if one thing is omitted, the head immediately sinks. But its satisfaction amply rewards the trouble of learning it. To hold a foot out of the water is very different; for both the hands must gather the waters together, striking them under you and driving them off, whilst the other leg must not be raised more than half, and the water frequently beat with it by quick and short strokes. Thus may any thing fastened to the toe be carried across a river. But this may be done better by holding up the hands; and to do this, care must be

taken not to contract the thorax or breast, which would sink a person, but on the contrary, by holding in the breath, to keep it filled as much as possible while the arms are held up. To hold both feet out of the water is more easy, which may seem paradoxical; and may not only remain in one place, but may get forward. This is done on the back, the small of which must be bent; and the hands being on the belly, move the palms open to and fro, which serve as oars to support the body till you examine your feet. Sitting upon the water is something like this; for you are to take both legs in your hands, draw in your breath that the breast may be inflated, hold the head upright, and lift up successively the arms and legs, and so sustain yourself.

It is very curious to creep upon the water like a snake, but it is very useful to get clear of weeds. When you are upon the belly, cast the arms and hands forwards as far from the breast as possible, and the feet (close together) softly backwards. The fingers must be close, and the palms of the hands a little bent, and turned towards the bottom. In this position, draw the water towards the breast with the hands and arms; by this means the body will have time to advance farther, and a person may gradually and gently disengage himself from weeds. But the hands and arms must not be used too vigorously, lest he should be the more entangled, and so be in danger of perishing.

Some of the most curious artifices of this nature are those of *ringing the bells*, *roasting the goose*, *treading the water*, &c. &c. The first may be done either on the back or belly; if the latter, draw in your feet at once, and strike them out forwards as before you did backwards, at the same time striking the hands out backwards, and putting the body in an upright position. If the former, draw the legs in at once towards the hips, and, striking them down towards the bottom, cast the body forwards till you are turned on the belly; always taking care, in these manœuvres, that you have sufficient depth of water, and that the bottom is free from weeds.

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To roast the goose, either by turning from right to left, or the contrary; if the former, and you are then swimming on the belly, extend the right hand and arm as far before you as you can, turning your whole body towards the left, by lifting up your right hand towards the top of the water you will be on your back, from which you may turn again on your belly, and so continue as often as you please. Do the contrary, if from left to right. If the legs are kept close together, and the arms stretched out right before the breast, at but a small distance from each other, this may be done very speedily.

Before you attempt to tread the water, you should learn to stand erect in the water without touching the bottom. When you are in a swimming position on your back, with your legs extended, let your legs descend till they come to be perpendicular, when you must take them up again, bending the knees and drawing in your breath. The arms and hands, of which the back parts lie flat on the water by the shoulders, must be extended sometimes on the one side, and sometimes on the other; shut them sometimes, turning the palms towards the bottom, with the fingers close to one another, and hold the chin as upright as possible. Thus you may move the water round with your legs from you, the soles of the feet being perpendicular to the bottom. A person bound hand and foot, and thrown into the water, may use it; and thus may one, having the use of the hands, defend himself against another. If the bottom is full of rushes or weeds, the left foot may be held up by the right hand, and the contrary, changing those holds by speedily striking down such foot; and in like manner may the other be held up, and so the legs, as occasion requires, may be disentangled from weeds.

If, when you are in an erect position, you have a desire to turn to the right, first embrace the water with the sole of the right foot, and then with that of the left, at the same time inclining the body that way. Draw the water towards you as much as you can with the hands, and afterwards drive it off again; first drawing it with the left hand, and then with the right, and
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so successively driving it back. Thus a person may turn round on every side, either to find a safe landing place, or to guard against an enemy.

It only remains to give a few directions for Diving, the utility of which needs no comment. You must first begin, standing with your feet on the bottom; then rising up, your head being bowed down that your chin may touch the breast, and the crown of it towards the bottom, hold the backs of your hands close together right before it. Strike them down towards the bottom as swiftly as you can, and you will soon descend. Some persons, in very deep water, will leap from a bridge or ship, either a little forwards or upwards, and so descend very swiftly, with the head perpendicularly downwards; but many accidents confirm the practice to be dangerous: it is therefore better to swim under water, being free from danger and very pleasant. Having first dived down, by turning the hands back to back, and close to one another, with the thumbs turned upwards, and the fore-finger towards the bottom, and thus extending them as swiftly as you can; to descend still lower, strike them down, while extended, lower in the water, but to re-ascend, keep the palms of the hands open towards the bottom, as when you swim on your belly above water. But to swim in the middle, grasp the water forwards with both arms, attracting it towards the body, the thumbs being turned a little more towards the bottom than the rest of the hands. A person may by this method seek for any thing at the bottom, or pass from one shore to another unseen.

To save a person in a state of drowning, keep at a distance of ten or twelve feet, and do not lay hold of him till he is quite sunk down, or has lost the use of his sight; because if such a one should, in that case, take hold of you, your life will be lost. But when you can safely attempt it, seize him by the hair, and draw him on your back, carefully observing that he does not entangle you; and so drawing him to some shallow place, or, by means of a rope fastened to his body, the other end being on shore, he may be easily brought

brought to land. Of this we shall say more, when we give the methods for recovering drowned persons.

To return from the bottom of the water, proceed much in the same manner as before; but to turn one's self in the water, the person who swims with one hand extended must push from him the water before him with his palm, drawing towards him with the cavity of the other palm the water which is behind him. When the hand is extended as far as it can be, shut or clench the fingers of such hand, and the palm of that turned outwards. But in searching for any thing, it is necessary to swim about the place, if not immediately perceived; to make a circle, therefore, beginning at the right and ending at the left, grasp the water with both hands from right to left, and the contrary if you would turn the other way. Never descend so far as to lose the light; when that begins to fail, you may conclude you are either too deep, or under some vessel, or the shore or shelving rock, &c. When you find this to be the case, recollect whereabouts you are, or which way you came thither, and turning back, look upwards for the light. Never attempt to breathe under water.

Sometimes it may be necessary to manœuvre, to avoid any person laying wait for your coming up. After two or three strokes dive down, the deeper the better, if you have light, when you may either swim forward, or keep under water in the same place as long as you can hold your breath; when you can hold it no longer, come up to breathe, and then dive again as often as may be necessary. In summer a person may swim eighty yards under water without taking his breath; this might save many lives, and is useful for avoiding many dangers. This is called the dolphin manœuvre.

On Restoring LOST ANIMATION.

THERE are so many ways in which the powers of Animation may be suspended, and so many lives are suffered to perish, for want of administering proper helps, that every endeavour to assist the ignorant with suitable means of restoring the vital powers, when apparently lost, is entitled to a favourable reception.

Drowning may be considered as the chief, though not the only cause of this sudden cessation of the vital powers. The present age is distinguished for its philanthropy; and men of science no longer confine their knowledge of the necessary aids for rescuing unhappy mortals, whether from accident or frenzy, from a state of death. The rewards which are promised and regularly paid to all that are instrumental in the recovery of drowned persons, and the pecuniary emoluments held out to encourage the attempt, as well as the pleasure resulting to the feeling mind, strongly recommend to our notice this subject as not unworthy of our plan.

It is certain, from experiments, that life may be restored after respiration has for some time ceased. More than two hours have sometimes elapsed before signs of life have discovered themselves; but even such cases have been successfully persevered in, which is reason sufficient not to give such persons over too hastily.

The first step, usually, after discovering a body and getting it out of the water, is, to hold up the feet higher than the head, and so endeavour to drain some of the water out of it; but this will not always succeed. Dr. Mead recommended, after wrapping up the person warm, to blow tobacco-smoke into the body, and to shake and roll it about, rubbing it in bed with warm cloths; for the great object in such cases is, to put the blood in motion by any means which can be thought of. Children may be held on the knee, wrapped

ped up in a warm night gown, before the fire, their head being lower than the feet, keeping them in continual agitation, and gradually increasng the fire till it burns very fiercely. When signs of life appear, volatile spirits or salts may be used with good effect: they may also be put into a warm bed or cradle, with a bottle of hot water at the feet, not to scald them, and a small quantity of good brandy may be put into the mouth. Where tobacco is not at hand, a few blasts of a pair of bellows have often brought a person in that state to life, and by continuing with discretion and prudence have produced every sign of restoration; after which a warm bed and proper care, as before mentioned, generally effect a perfect recovery. To rub the body all over with salt, particularly about the breast and joints, will by perseverance commonly succeed.

Another good remedy is, for a person to blow with a pipe or tube into the mouth of one taken out of the water very strongly for some time, so as to make the lungs heave and swell; taking care to pinch the nostrils to prevent its return through the nose, and there is seldom any fear of overdoing it in using this remedy.

As our limits will not admit of enlarging on this subject, the celebrated and philanthropic writings of Dr. Hawes and Dr. Fothergill must be referred to, and the directions published under the name and patronage of the Humane Society, instituted for the recovery of drowned persons. But these hints, it is presumed, communicated in this manner, may excite the attention of some, to whom these gentlemen or their writings are little known; and perhaps may prove a means of diffusing some useful knowledge on so benevolent a subject.

Many other cases of suspended animation may occur, where a similar treatment may be serviceable. To fill the lungs with warm air has often been attended with success in suffocations from charcoal, sulphur, &c. We wish not to be considered as writing to inform medical gentlemen, otherwise the numerous advantages of this method might be made to appear with convincing powers.

It

It is conjectured by many eminent physicians, that the vital power never totally forsakes the principal vital organs, however it may desert the external parts, so long as they retain the smallest degree of heat. What, therefore, have been generally considered as signs of death, must be very uncertain; nor are we to suppose that the pulsation of the arteries or respiration are totally extinguished, though they become invisible to the eye, and imperceptible to the touch; for we cannot affirm that any thing less than a beginning putrefaction can ascertain the absolute certainty of death.

To the additional instance already given of the possibility of recovery from the effects of charcoal, we may subjoin the case of apoplexies and fainting fits, and others arising from any violent agitation of mind. The effects of opium and spirituous liquors producing the signs of death have been counteracted and overpowered; a solution of tartar emetic conveyed into the stomach by a proper tube, or any other means to excite vomiting, will very frequently produce the happiest effects. Convulsions in children, which often occasion all the appearances of death, have been overcome by this means; and there is an instance on record of a girl about seven years old, who, being suddenly seized with a fit, and having before had a bad cough, was given over by the physician as irrecoverably lost (the heart and lungs having not only ceased to perform their office, but the lips and cheeks being pale, and the temples sunk), and was recovered as follows: A clyster was administered to satisfy the afflicted parents, and the wrists chafed with spirituous water, without any signs of life; then the soles of the feet were rubbed with strong brine, which being continued for three quarters of an hour without intermission, she began to breathe, and the friction was then increased. After two or three deep inspirations, the child was restored to life and health; the physician and the attendants being equally surprised as the happy parents were delighted. Dr. Buchan, in his Domestic Medicine, mentions his recovering a person taken up for dead by a fall from his horse, after six hours endeavours, during the greater part of which time he
hardly

hardly shewed any signs of life. Persons strangled, as well as those stunned by a fall or blow, must also be treated nearly upon the same principles; wherein every method should be tried to retain and preserve the genial warmth, and, by increasing it, to restore the vital powers to their due offices.

Such instances are sufficient to shew how necessary it is that every means of recovery should be used, and that perseverance may sometimes succeed beyond all hopes of success; and, if possible, under the direction of some experienced medical gentleman, who might vary them as circumstances should seem to indicate. It is more than probable, that many children carried off by convulsions are prematurely numbered with the dead, by neglecting the means of recalling life; and perhaps many who perish by accidents are really lost for want of proper care.

It often happens in fevers, especially in weak habits, where the debility is so great that the patient sinks into a state so nearly resembling that of death as to deceive the attendants. This also may arise from excess of bleeding, or other means which have been tried with a view to reduce the fever; in both cases, if volatiles, such as eau de luce, &c. were applied to the nose, rubbed on the temples, and often sprinkled about the bed and in the room, and if hot flannels also, moistened with a strong solution of camphorated spirit, were applied over the breast, and renewed every quarter of an hour, the undertaker might often be disappointed, and a valuable member restored to society, too often consigned to the grave from ignorance or motives of interest. A tea-spoonful of the strongest cordial should be given every five minutes, as soon as the patient can swallow. Not only in these cases, but in the small-pox, when the pustules sink, and death seems to ensue, the same methods are highly proper, as well as in any other acute disorder, when the vital powers are stopped from a similar cause.

We are happy in having procured the following surprising instance of recovery from the effects of drowning; as perhaps its equal has been seldom, if ever, heard of.

On or about the 4th of September, 1777, Philip, son of Philip Hibbs, of the town of Romley, Cooper, then about 8 or 9 years of age, fell into the water at Church-bridge, and was carried by the current for more than 200 yards under the houses, and a considerable time after his cloaths were discovered by a person passing, without knowing what it was. Being got out, he was brought to the shop of Mr. John Bartlett, surgeon, an hour or more after the accident, to every appearance totally deprived of life, and stiff with cold; not the smallest pulsation remained, nor the least symptom of life could be discerned. No time was lost to inflate the lungs and intestines, and the abdomen and extremities were at the same time incessantly rubbed with salt; this continued above three hours, when at last a small indication of returning life appeared by a hiccup in the throat. By continuing the inflation, and rubbing with salt as at first, farther signs of life were perceived by hiccups more frequently repeated. He was then put into a warm bed, and the inflation was still unremittingly continued; a vein was afterwards opened, which in the course of an hour bled to the amount of about five ounces. A small pulsation was soon after felt in the wrist, when, having poured some brandy into his throat, a vomiting immediately ensued, and he was then in a very short time restored. From the first commencement of this amazing operation to this state of the patient, near six hours were spent with unremitting exertion; and the recovery, consequent upon this singular perseverance, was at last happily and wonderfully effected, to the utmost astonishment of every person present. The succeeding day he came down stairs, and joined his companions as usual, without the least inconvenience; nor did he experience the smallest recollection of what passed from the time of his falling into the water to the time of his perfect recovery. He is at present (Dec. 1787) alive and well, and is constantly employed in the business of his father, who can attest, with many others, the authenticity of this account.

Same

Some necessary Observations respecting the WEATHER, in the Use of the BAROMETER or WEATHER GLASS, the THERMOMETER and HYGROMETER, and how to take out Wind Bubbles from the Tubes of BAROMETERS.

NOTWITHSTANDING the numerous writers of the highest authority upon this subject, the nature of this valuable instrument is little understood by the bulk of mankind. And it may be presumed that there is no better means of rendering this knowledge more general, than by offering a few observations in a work of this nature.

Some of the manufacturers of these instruments have indeed given their purchasers a printed extract of the usual effects of the several appearances from Dr. Halley, Mr. Patrick, or some other eminent author; but these, however just, very often disappoint those who implicitly rely upon them: and for a very good reason, that more is expected from them than their authors ever intended. For the weather, though it frequently may, does not always depend singly upon the density or spring of the air, by which the mercury in the tube is alone affected; the heat or cold of the air has also much influence on the weather, and for this we must have recourse to the thermometer. On this account it is that both are frequently placed in the same frame. But still a third instrument is necessary to point out the degrees of dryness and moisture of the air; hence it has obtained the name of Hygrometer, of which various sorts have been invented by the ingenious, and some of them exceeding simple, though equally useful. From a due consideration of these three causes jointly, and not from any one of them singly, can the weather with any probable degree of certainty be prejudged or foretold.

Many reasons might be assigned to prove the necessity of such general attention, instead of confining our observations to the barometer only. But it shall suffice to observe, that whatever tendency there may be

in the air to rain, from the appearance of the barometer; if the natural state of the weather be that of drought, in vain may such a confined observer expect rain from this cause alone, unless the hygrometer indicates an increase of watry vapours in the lower region of the air. On the other hand, the barometer in a rainy season may sometimes lead an observer to expect fair weather; but he will most probably be disappointed, if the hygrometer does not shew a tendency in the air to returning dry weather.

If it should be answered, that a good barometer will generally point out the weather which follows in consequence of the rise or fall of the mercury or quicksilver; it must be observed, that it cannot happen otherwise, when the counteracting state of the thermometer in respect of heat, and of the hygrometer as relating to the dryness of the air, are not sufficient to prevent the natural effects of a slender atmosphere. But the warmest admirers of the barometer never carry their enthusiasm so far as to maintain that they can depend on its indications at or about the equinoxes; which seasons are pointed out before on p. 337. I will not assert that, with the aid of the thermometer and hygrometer, the sudden and violent gales of those seasons may with certainty be foreseen; but I wish to recommend a careful attention to the appearances of each instrument, being strongly impressed with an idea that much information might be obtained by this means, at these parts of the year, from accurate observations and judicious remarks.

From these considerations, it may be natural to infer, that a great expansion or rising of the thermometer, especially if accompanied with any previous signs of moisture in the hygrometer, may be productive of thunder storms or hasty showers; and this at a time when there may not be any indication of rain from the barometer, but rather the contrary frequently. But this, for the improvement, and to excite the emulation of the young student, is rather offered as a conjecture from theory, than asserted as an established fact; yet a series of good observations, made by men of even ordinary

dinary talents, would probably afford matter for establishing many curious and pleasing conclusions.

As the hints here given are intended for those persons in general, whose education has not been the most liberal, nor their advances in science very far extended, the instructions commonly given with those barometers and thermometers which are both in one frame, shall be considered as preparatory to these remarks, and, for brevity's sake, shall not here be repeated. But as the hygrometer is still wanting, it seems necessary to point out some easy methods of supplying the deficiency, which any person of common ingenuity may easily prepare.

The pleasing device of Adam and Eve's alternate advances from their temple or habitation is well known. And here the gentleman's complaisance is sufficiently evident, in sending the lady abroad in fine and dry weather, while he stays at home to mind their family affairs; but, on the other hand, did not the mechanism and construction of the piece make it necessary, we should not much relish the uncivil return of being always sent abroad in moist and wet weather, because, forsooth, my lady chuses then to stay at home. But, humour aside, the whole contrivance is only this; that from the roof of this diminutive temple, the two figures at each end of a small bar of suitable length, are suspended by a piece of a viol string to the center of such bar, so as to be equally poised, which string contracts by moist weather which draws the gentleman out, and expands in dry weather which brings my lady abroad. Some persons suspend the figures in like manner without the house.

I have seen some ingenious devices, used by persons in the lowest class of life, for the purpose of discovering the changes of weather; and so far as such changes depend on the dry or moist state of the air, so far they will answer the proposed intention. One of these, which is exceeding simple, I shall here mention. Take a piece of hard twisted whip cord, which fasten at each end by means of nails to a wall, which is not much affected by changes of weather, so that by means of a moderate weight, or other moderately heavy body to

keep it straight, it may hang considerably lower in the middle than at each end; as the air becomes dry, it will expand, and so descend still lower in the middle, and as it increases in moisture, the cord will contract, and the weight will in consequence be raised. And such an hygrometer as this may be made by any person; and the greater the distance the two ends of the cord is, the more sensible will be the variations of the weight, &c. in the middle, which, to be more particular, may have an index fitted to it, and divisions may be formed upon a piece of paper pasted to the wall. Or this may be made moveable upon a piece of board planed smooth for the purpose, on which the divisions may be marked as before. Of the former kind, in their most rude and simple state, I have seen many in the houses of shepherds and labourers, as well as of farmers and some yeomen, in some northern counties of this kingdom.

For all the purposes of utility these common and simple devices might abundantly suffice. I shall therefore mention but one more amongst an amazing variety which might be produced. To one end of a slender beam let a thin but tolerably large piece of sponge be suspended at liberty by means of a fine silk thread, and on the other part of the beam, at a convenient distance from the center, balance it by another fine silk thread, which must be strung with the finest lead shot at equal distances and of equal size. Under this thread a small table or shelf must be fixed higher or lower to adjust the other end of the beam, lengthened out into a small index, so that it may be straight or horizontal when the air is in a mean state between extreme drought and extreme moisture. This table is for the purpose of receiving so much of the silk or shot as is not suspended from the beam; and if the arch to be struck by the motion of the index is graduated from one extreme to the other, the several divisions of dryer, dry, little dry, middle state, little moist, moist, moister, will shew the intermediate state of the air from that of greatest drought or very dry, to that of greatest moisture or very wet. It must be observed, that the longer the index is drawn out, so
that

that the equilibrium is not destroyed, the larger scope will the arch contain under the same angle, and the variations will sooner be discovered.

It only remains to add a very few words respecting air bubbles in weather glasses, and the means of removing them. If it be suspected that any of the quicksilver is lost, as is usually the case in such accidents, fill the tube within an inch or less; then put your finger on the orifice, and very gently and gradually invert it, by which means not only the air in the vacant part will ascend along the tube, but it will collect all the little air bubbles with it. Having done this, change the tube very gradually into its natural position, and immerse the orifice in a vessel of quicksilver before the finger is removed; by this means the quicksilver will subside to its proper height in the tube, which will be somewhere between 28 and 31 inches, and thus the tube is rectified. In the same manner are barometer tubes filled; always observing to move them very gently, or the weight of the quicksilver will break the tubes.

Of the AURORA BOREALIS, or, as it is usually called, the NORTHERN LIGHTS.

THE frequent opportunities of viewing this pleasing and beautiful illumination of the air or atmosphere in a very splendid state, which have within these few months * occurred to the inhabitants of this kingdom, very naturally incline us to give some account of their cause. And this appears to be the more necessary, because they are in general little understood by the common class of people; who, upon every remarkable appearance of this nature in the heavens, usually fancy that they can see the marching of armies, their attacks and retreat, with twenty other chimeras, which immediately are applied to the political events of

* Viz. for a few months before December, 1787.

of the day, and conclusions deduced as suit the genius or humour and disposition of the observers.

How far vulgar prejudice may operate against the matter contained in this article, is uncertain; it is sufficient to remark, that its effects are sometimes very great, even on subjects more proportioned to the capacity of people in general than the present. It has often been asserted with much confidence, that this lucid appearance of the heavens was altogether unknown till the year 1715; and from hence they consider it as a sign or omen of the disagreeable political condition of this kingdom at that period; and the same impression which was then made has been handed down traditionally from father to son to the present times, that these appearances must always produce similar effects. But this assertion cannot be supported upon any ground or reason whatever; for it is contrary to every principle of nature and of science to suppose that such phenomena never before existed, as it would have been much more probable that, upon such an hypothesis, they must have been more frequent and more awful in some part of the period from 1642 to 1648.

That we have no accounts of any such appearances in those times, is not proof sufficient that there were none; as philosophy and science were then comparatively at a very low ebb in proportion to their present improved state. It was for such men as Sir Isaac Newton and Dr. Halley to examine into the causes of all the unusual phenomena in nature, and to open the fields of science to be traversed and explored by future adventurers; hence it became necessary to commit their several appearances minutely to writing, and hence their supposed origin has been confined to that period, in which they were more particularly remarkable. Nor can I be prevailed upon to think that the luminous appearances of that time are to be ranked among the first observations of the kind, as it is not usual for philosophers or men of science in any department to publish their remarks, till time and subsequent experiments seem to have confirmed them in their opinions.

I shall

I shall not attempt to describe the nature of their appearance, as few persons of common curiosity or attention can be ignorant of this; it shall be sufficient to observe here, what most of my readers must have remarked, that the phenomena are by no means confined alone to the north parts of the atmosphere. The following brief and natural account of their cause shall suffice for the conclusion of this head.

As it cannot be denied that vapours of a mixed nature, partaking of the qualities of nitre or saltpetre, and sulphur or brimstone, abound in the air; when these are so thin and subtle as to rise high in the atmosphere, the natural current of air which is known to subsist at a distance from the equator will carry them towards the north pole. Here, therefore, they are collected together, and the fermentation occasioned by such motion of inflammable matter, on meeting with particles proper for producing it, is the cause of those fiery streams we constantly see in the phenomena. And as these vapours, once kindled, will naturally kindle others which are near them, so must these flames and dartings succeed each other, till all the vapours within reach are exhausted and consumed; hence it is, that when these are dispersed over the atmosphere in considerable quantities, the appearance is general, and for some time, when they abound, they may be observed of a blood-red colour, which may be considered as of the nature of a strong and steady fire. From which observation we may be easily satisfied which parts of the upper regions of the air are most strongly impregnated with these nitrous and sulphurous vapours; and from hence it may be concluded that these only differ in degrees of density or substance, and not in quality, from those grosser particles which, on being collected together by attraction, produce lightning. For of this nature, it cannot be doubted, is that mixture of vapours in the lower regions of the air, which occasion those terrifying and awful streams of fire called lightning, and those loud explosions to which we have given the name of thunder.

*On the Nature of ANNUITIES for Life, LEASE-
HOLD ESTATES for Life, &c. &c.*

IN prosecuting this subject, which with pleasure is embraced in concluding this work, the most useful information may be expected. For though in some parts of this kingdom such kinds of tenures are but little known, and as little understood, in others they are so common, that the utility of this branch of the work must be obvious at first sight.

The learned Dr. *Halley*, of whom mention is made in other parts of this book, laid the foundation for future political arithmeticians to improve upon. For it is only by repeated experiments and observations that the probability of the continuance of life can be ascertained; and later writers have zealously and patriotically employed their pens in this department, which is intimately connected with the riches of every state, viz. the gradual increase or decrease of the number of the people it contains.

As the modes usually adopted for grounding the theory of annuities upon, are most natural in themselves, and best proportioned to deduce suitable consequences from; it may perhaps seem surprising to the reader to be informed, that the purchasers of annuities on lives will frequently advance from one and a half to two years purchase upon lives of twenty years and upwards, beyond what the tables for this purpose do specify. But as these are calculated from general principles, there must certainly be some other cause assigned for placing such greater value upon the life of persons after this period. It shall be the present business of the author to shew the probable cause of this difference; and also to point out some other particulars, which, the more generally they are encouraged, will be productive of still greater advantages to the nation at large in preserving many lives to a longer period, and also to individuals, in causing a proportionable increase of the value of annuities granted upon lives.

In

In assigning to the reader the occasion of this difference or advance in the value of annuities, it must be remembered, that the proportionate numbers of those persons who die from year to year through the several periods of life, have been necessarily taken from observations made in some great cities or towns. This has given rise to the different values which have been and still are placed to the account of persons of mature age; for as it is reasonable to suppose that those who purchase annuities upon their own lives will at least reside in the country some part of the year, the advantages in respect of health and the continuance of life, which are very considerable, are certainly of great and momentous consideration. And the same reason may be supposed to operate on the minds of those who are purchasers of the lives of others; which must enhance the purchases of which I am treating in such a degree probably as has been mentioned.

Another reason may be given for this difference, which may also concur in operation with the last, that in seasons of political plenty some purchasers may be satisfied with making a lower interest of their money than others; this will always be productive of an advance of the original purchase, and cause the effect of which I am writing. But it will always in some degree produce this singly, and much more when it is considered in conjunction with the former.

Yet it is not intended to stop here. In surveying with an observing eye the political arithmetic of this kingdom, we now find some powerful antidotes against the decrease of population, such as may be called new sources of population and increase of inhabitants, which till an advanced period of the present century were totally unknown to this kingdom. The small-pox, which formerly made such ravages as to cut off every fifth or even fourth person attacked with it, is now, by the happy introduction of inoculation, checked in its career; and by means of the numbers of lives saved, a new system of observations must necessarily supersede the old, and a new state of the number of persons dying in each year must consequently lay the foundation for a new set of tables of the probability of life in all ages.

To

To this consideration may be added the many lives which have been preserved and restored to the community, by means of the numerous hospitals and other charitable foundations in the metropolis, and in almost every county in the kingdom. Such causes have certainly operated to enhance the value of annuities upon lives in a very considerable proportion.

If I may be indulged with hazarding another cause, which might operate to this salutary effect, I would instance in the gradual and rapid advances which the people of this kingdom are in general making to the free exercise of their rational faculties, and the proportional removal of the mists of prejudice. To be more particular, the sources and effects of diseases incident to the human body, seem to be better understood amongst the bulk of mankind than in former ages; but, throwing out this only as a hint for the reader to speculate upon, I mean to refer him to the observations elsewhere (see p. 388) on the causes and cure of consumptions of the lungs. This is a subject well deserving his serious and attentive consideration, and is in a peculiar manner applicable in the present case.

Having observed that tables have been formed from a careful attention to the bills of mortality, compared with the births, in cities and towns; I shall here proceed, notwithstanding the proportional advantages of life in the country, to shew the use of them, according to the latest statement which has been given of the decrease of lives of any proportionate number of births. For as the public must still be content with such tables as can be procured for them, it is scarcely to be expected, so comparatively great is the difference of country situations in respect of health, that any tables can be formed more generally correct than those we now have. It must therefore be left to the judgment of persons interested, to consider whether any advance may be made in the purchase of annuities on lives, and how far*; as perhaps it nearly agrees, without any

* From observations made in smaller towns, such as Norwich and Northampton, the chance of life is in favour of these towns in proportion of three to two.

such advance, in its present state, to the London bills of mortality. Such then are the tables proposed for the reader's information; in which I shall, 1st, give an account of the proportionate number of deaths in each year, and from thence, 2dly, deduce the several expectations of the contingency of life at different ages. After this I shall proceed to give a table, shewing the number of years in which an annuitant will have his purchase-money reimbursed, at the rate of interest he may propose to make of his money. And from hence arises another consideration, which is, to find the present worth of such annuity, according to the number of years purchase, which will discover the price to be paid for such annuity; this will form another table, which is the table most useful, and to which the former are chiefly preparatory.

The method hereafter recommended of deducing the second table from the first being new, the following is here given as the most usual way; leaving it to the student's choice to adopt that which he thinks proper.

To find the Value of an Annuity upon a Life of a given Age.

Rule. Subtract the given age from 86, the supposed extent of human life, and find the present value of an annuity of 1*l.* at the given rate per cent. for that difference. Multiply this by the amount of 1*l.* for one year, and divide the product by the difference found, subtracting the quotient from unity or 1. Then divide this remainder by the decimal of the rate of interest, and this last quotient expresses the value of the annuity for that life as required.

N. B. Tables in like manner may be constructed for half yearly payments, by using the amount and interest of 1*l.* for half a year.

*A TABLE of the Probabilities of Life, from the latest
Observations made at London.*

No. of Persons.	Ages compl.	No. of Persons.	Ages compl.	No. of Persons.	Ages compl.	No. of Persons.	Ages compl.	No. of Persons.	Ages compl.
1518 born 486 sub.		522 — 16 7 sub.		395 — 32 9 sub.		242 — 48 9 sub.		118 — 64 7 sub.	
1032 — 1 200 sub.		515 — 17 7 sub.		386 — 33 9 sub.		233 — 49 9 sub.		111 — 65 7 sub.	
832 — 2 85 sub.		508 — 18 7 sub.		377 — 34 9 sub.		224 — 50 9 sub.		104 — 66 7 sub.	
747 — 3 59 sub.		501 — 19 7 sub.		368 — 35 9 sub.		215 — 51 9 sub.		97 — 67 7 sub.	
688 — 4 40 sub.		494 — 20 7 sub.		359 — 36 9 sub.		206 — 52 8 sub.		90 — 68 7 sub.	
648 — 5 36 sub.		487 — 21 8 sub.		350 — 37 9 sub.		198 — 53 8 sub.		83 — 69 7 sub.	
622 — 6 29 sub.		479 — 22 8 sub.		341 — 38 9 sub.		190 — 54 7 sub.		76 — 70 6 sub.	
603 — 7 14 sub.		471 — 23 8 sub.		332 — 39 10 sub.		183 — 55 7 sub.		70 — 71 6 sub.	
589 — 8 12 sub.		463 — 24 8 sub.		322 — 40 10 sub.		176 — 56 7 sub.		64 — 72 6 sub.	
577 — 9 10 sub.		455 — 25 8 sub.		312 — 41 10 sub.		169 — 57 7 sub.		58 — 73 5 sub.	
567 — 10 9 sub.		447 — 26 8 sub.		302 — 42 10 sub.		162 — 58 7 sub.		53 — 74 5 sub.	
558 — 11 9 sub.		439 — 27 8 sub.		292 — 43 10 sub.		155 — 59 8 sub.		48 — 75 5 sub.	
549 — 12 8 sub.		431 — 28 9 sub.		282 — 44 10 sub.		147 — 60 8 sub.		43 — 76 5 sub.	
541 — 13 7 sub.		422 — 29 9 sub.		272 — 45 10 sub.		139 — 61 7 sub.		38 — 77 5 sub.	
534 — 14 6 sub.		413 — 30 9 sub.		262 — 46 10 sub.		132 — 62 7 sub.		33 — 78 4 sub.	
528 — 15 6 sub.		404 — 31 9 sub.		252 — 47 10 sub.		125 — 63 7 sub.		29 — 79 4 sub.	

Explanation and Use. This table supposes that the observation was made upon 1518 persons born; and that in consequence so many persons only remained alive at the completion of any particular year in life, as the number specifies which is placed against the number of that year. Hence it appears, that more than half of those which are born die before the end of three years; that not one-third live to complete their 19th year; not one-fourth attain to the age of 34; and not one-tenth to the age of 60*. For 747 remaining at the end of three years is less than half of 1518, 501 is not one-third of that number, 377 not so many as the fourth, and 147 not one-tenth part of the persons supposed to be born. In like manner, the comparative chances of life at any other age may be collected from hence, and the proportional probability of their living to any subsequent age ascertained. For if a person of 30 years of age, for instance, desires to know the chance of his living to the age of 75, the numbers 413 and 48 will shew the proportion, that out of 413 persons of 30 years, only 48 will attain to the end of 75 years of age, which is little more than a ratio of 1 to 9.

From hence may be inferred the probable chance of life at any age. For supposing the utmost extent of human life to be at 86, and that those who live beyond that age may be considered as phenomena, which are inadmissible in general calculations; the several expectations of life at different ages must from thence be determined, as we have already shewn, so far as our limits permit, from which, at the several rates of interest, the present value of any annuity to continue for that time may be ascertained.

PROBLEM. To find the probability or expectation of the continuance of a single life at any particular period of such life.

* At Northampton, it has been observed, that more than one-half will remain alive at the end of the ninth year, and more than one-third at the end of the 37th year; such is the great and pernicious influence of very great cities on health, and the advantages of residing in smaller towns.

Rule. Let the given age be sought in the preceding table, and observe the corresponding number which stands against it; then look below in the same table for the half of such number, or the nearest to it, and observe the year which stands against it, from which subtract the given age, and the remainder will be the expectation of life for that age. In this manner the following table has been calculated.

A TABLE of the probable Expectations of Life at different Periods.

<i>Age.</i>	<i>Expe^{ct}at.</i>	<i>Age.</i>	<i>Expe^{ct}at.</i>	<i>Age.</i>	<i>Expe^{ct}at.</i>	<i>Age.</i>	<i>Expe^{ct}at.</i>
1	15.86	21	26.85	41	17.86	61	10.08
2	27.66	22	26.28	42	17.50	62	9.66
3	31.55	23	25.72	43	17.12	63	9.25
4	33.66	24	25.16	44	16.75	64	8.83
5	34.90	25	24.61	45	16.43	65	8.50
6	34.95	26	24.05	46	16.14	66	8.20
7	34.95	27	23.50	47	15.86	67	7.90
8	34.75	28	22.94	48	15.57	68	7.60
9	34.35	29	22.44	49	15.21	69	7.30
10	33.85	30	21.94	50	14.86	70	7.00
11	33.30	31	21.50	51	14.50	71	6.66
12	32.75	32	21.06	52	14.14	72	6.33
13	32.15	33	20.62	53	13.71	73	6.00
14	31.50	34	20.21	54	13.28	74	5.65
15	30.80	35	19.86	55	12.78	75	5.30
16	30.10	36	19.57	56	12.28	76	4.96
17	29.45	37	19.14	57	11.78	77	4.58
18	28.80	38	18.78	58	11.28	78	4.18
19	28.15	39	18.41	59	10.72	79	3.70
20	27.50	40	18.14	60	10.42	80	3.20

From what has been already observed, the use of this table is obvious; concerning which it may be remarked, that it makes the ages of 6 and 7 years to have the greatest probability of the continuance of life, though tables in general make the 9th and 10th years of age to be most valuable, and some the 5th and 6th.
But

But as this entirely depends on the accuracy of the first table, which shews the annual decrease of lives; it may be sufficient here to have shewn the method of deducing the expectations of life from thence, or from others which have a better claim to authenticity.

The next step, in order to discover the present worth of an annuity upon any single life, must be to find the discount of one year to come at the proposed rate of interest; and the present worth thus found may be considered as a principal sum for finding the next year's present worth, and so on for the whole time required. But these calculations suppose the certainty of life for such time, whereas the contingency must be considered, and the probability of the person's life or death ascertained; and from hence it is manifest, that the discount of any annuity for one year to come must be increased, that is, the present value must be decreased, in proportion to the decrease of the lives in that year; because the contingency of the person's dying within that year lessens the value of the present worth in proportion to that contingency. For though the present value of 1*l.* payable one year hence, at 5 per cent. is 19*s.* 0.57*d.* certain; yet, taking in the contingency of receiving the 1*l.* at the end of the year, that sum must be lessened in proportion to the numbers against any two ages differing only one year from each other. By proceeding in the same manner for the next year, and so on to the number of years which the probability of life points out for any certain present age; the several values added together will give the true present value of an annuity of 1*l.* at the supposed rate of interest for that time. If the contingency in each year is regularly deducted as above, the real present value of an annuity for any given age will be obtained; and from hence, by a very easy and natural proportion, the following table may be deduced. For as the present value of any annuity for a certain number of years is to that annuity multiplied by the number of years, so is the same number to the numbers respectively given in the table.

A TABLE of the necessary Continuance of Life for reimbursing an Annuitant his Purchase-Money at several Rates of Interest.

Years Purch.	2½ p. Ct. Y. D.	3 per Ct. Y. D.	3½ per Ct. Y. D.	4 per Ct. Y. D.	4½ per Ct. Y. D.	5 per Ct. Y. D.
5	5.149	5.182	5.216	5.252	5.289	5.327
5½	5.362	6. 37	6. 79	6.122	6.168	6.216
6	6.212	6.261	6.313	6.364	7. 55	7.113
6½	7. 66	7.124	7.184	7.247	7.314	8. 20
7	7.289	7.356	8. 62	8.137	8.217	8.303
7½	8.149	8.227	8.311	9. 34	9.129	9.231
8	9. 13	9.104	9.200	9.304	10. 51	10.172
8½	9.246	9.350	10. 97	10.217	10.348	11.125
9	10.118	10.236	11. 11	11.138	11.290	12. 92
9½	10.358	11.128	11.274	12. 69	12.245	13. 75
10	11.237	12. 24	12.191	13. 9	13.212	14. 75
10½	12.121	12.292	13.115	13.324	14.194	15. 94
11	13. 9	13.200	14. 48	14.286	15.190	16.134
11½	13.266	14.115	14.354	15.259	16.203	17.196
12	14.162	15. 36	15.305	16.246	17.234	18.285
12½	15. 64	15.329	16.265	17.246	18.285	20. 38
13	15.335	16.264	17.235	18.261	19.358	21.189
13½	16.246	17.206	18.216	19.292	21. 90	23. 13
14	17.163	18.156	19.209	20.340	22.215	24.247
14½	18. 85	19.115	20.215	22. 43	24. 5	26.168
15	19. 12	20. 82	21.234	23.132	25.195	28.151
15½	19.311	21. 59	22.267	24.245	27. 60	30.209
16	20.215	22. 45	23.316	26. 18	28.336	32.360
16½	21.197	23. 41	24. 16	27.185	30.300	35.164

Explanation and Use. The first column, which contains the number of years purchase, for every half year, from 5 to 16½, must be entered with the number of years purchase the annuity is supposed to be bought at. The other columns shew, in years and days, what time will be necessary for the annuity to produce the purchase-money according to the several rates of interest proposed at the top of each column. Thus, if a person gives 13½ years purchase for an annuity, to know what time such annuity will repay him at 4½ per cent. per annum for his money, against 13½ in the 1st column, and under 4½ per cent. in the 6th column, is 21 years and 90 days, and so long must the annuity be received to reinstate the purchaser thereof in

in his money. Hence, if we should suppose the probability of the continuance of life of a person at any age to be 21 years and about a quarter, the full purchase would be no more than 13 years and a half, reckoning interest at $4\frac{1}{2}$ per cent.

Again, if a person purchases an annuity, upon a life of 40, and gives 13 years purchase, it may be inferred from hence what rate of interest such purchaser will make of his money. For if you enter the table of the probable expectations of life with the age of 40, you will there find that it is 18.14, or 18 years and about 51 days. For this number you are to cast your eye along the line of 13 years purchase, and the nearest number to it is 18 years and 261 days; which being greater, shews that such a purchaser, according to these tables, will not have quite 4 per cent. for his money. But we have seen, that by the advance of about 1 year and a half in the purchase, if we look against $11\frac{1}{2}$, you will find that the purchaser of such annuity will make more than 5 per cent.

From hence we collect another use of the preceding table. Having estimated the value of any life, by the probable expectation of the number of years to come, seek in the column under that rate of interest which is proposed to be made for the number of years and days nearest to it, and against it in the first column is the number of years and parts at which such annuity must be purchased. For instance, if the expected continuance of the life of any person be 14 years, at what number of years purchase may an annuity on such life be done, interest being allowed at 5 per cent.? Here in the 5 per cent. column I find 14 years and 75 days, or about one-fifth more, against which in the 1st column is 10 years purchase; and so much, or very little more, is such an annuity to be valued at. But this will be more readily discovered by the following table.

A TABLE

A TABLE of the Value of Annuities on a single Life, at several Rates of Interest, for all Ages under 80.

Age.	3 per Ct.			3½ per Ct.			4 per Ct.			4½ per Ct.			5 per Ct.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
8	19	14	8	18	3	2	16	15	9	15	11	10	14	10	10
9	19	17	4	18	5	4	16	17	7	15	13	5	14	12	1
10	19	17	4	18	5	4	16	17	7	15	13	5	14	12	1
11	19	14	8	18	3	2	16	15	9	15	11	10	14	10	10
7.12	19	12	0	18	0	11	16	13	11	15	10	4	14	9	7
13	19	9	4	17	18	8	16	12	0	15	8	8	14	8	2
6.14	19	6	7	17	16	5	16	10	1	15	7	2	14	6	10
15	19	3	10	17	14	1	16	8	2	15	5	5	14	5	5
16	19	1	0	17	11	9	16	6	2	15	3	9	14	3	11
5.17	18	18	1	17	9	4	16	4	2	15	2	0	14	2	5
18	18	15	2	17	6	10	16	2	1	15	0	3	14	0	11
19	18	12	2	17	4	4	15	19	11	14	18	5	13	19	4
4.20	18	9	1	17	1	10	15	17	9	14	16	7	13	17	9
21	18	6	1	16	19	3	15	15	7	14	14	8	13	16	2
22	18	2	11	16	16	7	15	13	4	14	12	9	13	14	6
23	17	19	9	16	13	11	15	11	0	14	10	10	13	12	10
3.24	17	16	6	16	11	2	15	8	8	14	8	10	13	11	1
25	17	13	3	16	8	4	15	6	4	14	6	9	13	9	3
26	17	9	11	16	5	6	15	3	11	14	4	8	13	7	6
27	17	6	6	16	2	7	15	1	5	14	2	6	13	5	7
28	17	3	0	15	19	8	14	18	11	14	0	4	13	3	8
29	16	19	6	15	16	8	14	16	3	13	18	1	13	1	9
30	16	16	0	15	13	7	14	13	8	13	15	9	12	19	9
2.31	16	12	4	15	10	6	14	10	11	13	13	5	12	17	8
32	16	8	8	15	7	4	14	8	2	13	11	0	12	15	7
33	16	4	11	15	4	0	14	5	4	13	8	7	12	13	5
34	16	1	1	15	0	9	14	2	6	13	6	0	12	11	2
35	15	17	3	14	17	5	13	19	6	13	3	6	12	8	11
36	15	13	3	14	13	11	13	16	6	13	0	10	12	6	7
37	15	9	3	14	10	5	13	13	6	12	18	2	12	4	3
38	15	5	1	14	6	10	13	10	4	12	15	5	12	1	9
1.39	15	1	0	14	3	3	13	7	2	12	12	7	11	19	3
40	14	16	10	13	19	6	13	3	11	12	9	8	11	16	8
41	14	12	6	13	15	9	13	0	6	12	6	8	11	14	1
42	14	8	1	13	11	11	12	17	1	12	3	8	11	11	4
43	14	3	8	13	7	11	12	13	7	12	0	6	11	8	7
44	13	19	1	13	3	11	12	10	0	11	17	4	11	5	9
45	13	14	6	12	19	10	12	6	5	11	14	1	11	2	10
46	13	9	10	12	15	8	12	2	8	11	10	9	10	19	10
47	13	5	0	12	11	5	11	18	10	11	7	4	10	16	8
48	13	0	2	12	7	0	11	14	11	11	3	10	10	13	6
49	12	15	3	12	2	7	11	10	11	11	0	2	10	10	3
50	12	10	2	11	18	0	11	6	10	10	16	6	10	6	11

TABLE continued.

Age.	3 per Ct.			3½ per Ct.			4 per Ct.			4½ per Ct.			5 per Ct.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
51	12	5	1	11	13	5	11	2	8	10	12	9	10	3	6
52	11	19	10	11	8	8	10	18	5	10	8	10	9	19	11
53	11	14	6	11	3	10	10	14	0	10	4	10	9	16	4
54	11	9	1	10	19	0	10	9	6	10	0	9	9	12	7
55	11	3	7	10	13	11	10	4	11	9	16	6	9	8	8
56	10	18	0	10	8	10	10	0	3	9	12	3	9	4	9
57	10	12	3	10	3	7	9	15	5	9	7	10	9	0	8
58	10	6	6	9	18	3	9	10	6	9	3	3	8	16	6
59	10	0	6	9	12	9	9	5	6	8	18	7	8	12	2
60	9	14	6	9	7	2	9	0	4	8	13	10	8	7	9
61	9	8	4	9	1	6	8	15	0	8	8	11	8	3	2
62	9	2	1	8	15	8	8	9	7	8	3	11	7	18	6
63	8	15	8	8	9	9	8	4	1	7	18	9	7	13	8
64	8	9	2	8	3	8	7	18	5	7	13	5	7	8	8
65	8	2	7	7	17	6	7	12	7	7	7	11	7	3	6
66	7	15	10	7	11	1	7	6	7	7	2	4	6	18	3
67	7	9	0	7	4	8	7	0	6	6	16	7	6	12	10
68	7	1	11	6	18	0	6	14	3	6	10	8	6	7	2
69	6	14	10	6	11	3	6	7	10	6	4	7	6	1	5
70	6	7	6	6	4	4	6	1	3	5	18	4	5	15	6
71	6	0	1	5	17	3	5	14	6	5	11	11	5	9	4
72	5	12	7	5	10	1	5	7	7	5	5	3	5	3	0
73	5	4	11	5	2	8	5	0	6	4	18	6	4	16	6
74	4	17	0	4	15	2	4	13	3	4	11	6	4	9	9
75	4	9	0	4	7	5	4	5	10	4	4	4	4	2	10
76	4	0	11	3	19	6	3	18	2	3	16	11	3	15	6
77	3	12	7	3	11	6	3	10	4	3	9	4	3	8	3
78	3	4	2	3	3	3	3	2	4	3	1	6	3	0	8
79	2	15	6	2	14	9	2	14	1	2	13	5	2	12	9
80	2	6	9	2	6	2	2	5	7	2	5	2	2	4	7

Explanation and Use. From what has been observed of the former tables, the nature of this must be obvious at first sight; shewing the value of an annuity of one pound at several rates of interest on any single life from 1 to 80, from whence the value of any other annuity is had, by multiplying this value by the pounds in such annuity. It will also be observed, that the ages of 7 and 12 are supposed to be of the same value; also of 6 and 14, 5 and 17, 4 and 20, 3 and 24, 2 and 31, 1 and 39. Hence also the age, whose life is of greatest value, appears to be from 9 to 10. But to give an instance, let us suppose an annuity of 70*l.* interest

terest being accounted at $4\frac{1}{2}$ per cent. to be payable on a life of 2 years, or of 31 years of age complete, to find the value; where is found, in the first place, 13*l.* 13*s.* 5*d.* which being multiplied by 70, will give 956*l.* 19*s.* 2*d.* the value of an annuity of 70*l.* for the life of a person of 31 years of age, or a child of 2 years of age.

LEASEHOLD ESTATES for LIVES are commonly granted for 99 years, determinable on the deaths of a certain number of lives, usually three; and generally renewable after one or two deaths, according to the custom of manors.

It is of much importance to the tenants of leasehold estates on lives to be acquainted with the real value of single lives, in order to know the value of the joint lives, on which the possession of such tenures depend. The original expence of purchasing such leases must be considered; to which must be added all expences in buildings upon ground-rents, &c. for the present value advanced on such premises; and from the supposed annual value of such premises, the annual rent reserved to be paid is to be subtracted, also the estimated annual value of what may be deducted on account of heriots, &c. Having thus ascertained the neat annual income to arise from such premises, the single value of each life to be mentioned in such lease, at the rate of interest supposed, is to be extracted from proper tables; and from hence the following rules are universally established for finding the value of two or three lives.

Rule 1. To find the value of two lives upon a lease, take the sum of the single values of each life, and also the product, which multiply by the pounds * in the rate of interest (taking parts, if necessary) and divide the last product by 100; subtract this quotient from the sum of the single values, the remainder will be a divisor with which to divide the product of the value of the lives, and the value of the joint lives will be expressed by the quotient. Subtract this from the sum of the values of the single lives, which will give the value of the longest.

* If the decimal of the rate of interest be used as the multiplier, to divide by 100 will become unnecessary.

Rule

Rule 2. To find the value of three lives upon a lease, multiply the value of the three single lives into each other for a dividend; then multiply the value of the first and second lives together, of the first and third, and of the second and third, and from the sum of these products subtract the reserved dividend multiplied by the pounds * in the rate of interest and divided by 50, which shall be a divisor; and the quotient thence arising will be the value of three joint lives. Then to find the value of the longest life, from the sum of the three single lives subtract the sum of all the joint lives combined two and two (i. e. of the first and second, the first and third, and the second and third), and to this remainder add the value of the three joint lives; this produces the value of the longest of three lives.

As my limits will not admit of enlarging, I shall only give an example or two for exercising the preceding rules.

Example 1. Suppose I wish to know what additional value will be given to an estate of 30*l.* a-year, nett income, by adding a life of 31 years of age to another of 37, reckoning interest at 5 per cent. per annum? Here the value of 37 under 5 per cent. is 12*l.* 4*s.* 3*d.* for every pound, and that of 31 is 12*l.* 17*s.* 8*d.*; which in decimals are 12.2625 and 12.8833, and their sum 25.1458. The product of the two values is 157.98, which multiplied by .05 gives 7.899; subtract this from 25.1458, and it leaves 17.2468 for a divisor. Then divide 157.98 by this divisor, and the quotient will be 9.16. This quotient is the value of the joint continuance of the lives, and if subtracted from 25.14, the sum of their single values, it will leave 15.98 for the value of the survivor's life. From this remainder take 12.26, the value of the oldest life, and it gives 3.76, to be multiplied by 30*l.* the nett annual value of the estate; which will produce 112.8*l.* or 112*l.* 16*s.* for the additional value of a life estate of 30*l.* a-year, nett money, by adding a life of 31 to one of 37.

Example 2. Suppose two lives of 56 and 27 are upon a leasehold estate of 30*l.* a year, nett income, and it

* See the preceding note.

it is desired to add a third of 6 years of age, to know what additional present value will be given to it, supposing interest at 5 per cent. per annum? Here the values of 56 and 27 under 5 per cent. are *9l. 4s. 9d.* or *9.2375*, and *13l. 5s. 7d.* or *13.2791*; also the value of 6 is *14l. 6s. 10d.* or *14.3416*. Then these three values multiplied together will give *1759.2222* for a dividend; also the value of the joint lives of the first and second life, by the first rule, will be *7.4872*, of the first and third it is *7.8136*, and of the second and third it is *10.5264*. Their sum is *25.8272*, to be subtracted from the sum of the values of the three lives singly, which is *36.8582*; and to *11.031*, the difference, add *6.5236*, the value of the three joint lives, as found by the second rule, and the sum *17.5546* is the value of the longest of these three lives. Now the value of the survivor of the two joint lives is *15.0294*; hence the difference *2.5252* multiplied by 30 gives *75.756l.* for the full additional value of a third life of 6 years, to two others of 56 and 27.

From hence the method of computing tables for shewing the value of joint lives, both for the time of their joint continuance, and also the value of the longest liver, is obvious; but this must suffice for want of room.

F I N

E R R



Page 27, line 4, for syllables, read vowels.

66, l. 20, r. none.

95, l. 5, r. 261.

98, l. 7, r. 1791. 4s. 8d.

116, l. alt. for 8d. r. 9d.

117, l. 17, for a qr. r. 1 qr.

118, l. 22, r. 21 07 09 17

221, l. 6, dele of ale

223, l. 2, r. 1 fathom.

l. 14, r. 30 yards and a quarter.

l. 25, for furlong.

r. rood. l. alt. for solar, r. common.

124, l. 1, dele solar.

148, l. 14, r. 411.

180, l. 9 and 18, r. 418176.

186, l. 3, r. 331 6s.

209, l. 14, r. double, triple, quadruple, or other certain ratio of that which precedes it.

210, l. antepenult. r. 18641.

231, l. 1, for ecliptic, r. equinoctial.

335, l. 10, for 37 deg. 27 min. and 37 deg. 40 min. r. 37. deg. 51 min. and

38 deg. 4 min.

